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Work Plan

**Phase II Environmental Investigation  
Port of Tacoma  
Property Transfers**

1.3

**Blair Waterway Property  
Inner Hylebos Property  
Upper Hylebos Property**

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9827

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## 1.0 INTRODUCTION

### 1.1 STUDY PURPOSE/OBJECTIVE

This Work Plan presents the scope of services, including work tasks and a detailed description of field investigation, sampling, testing, quality assurance, and health and safety procedures for Phase II Environmental Investigations to be conducted at the Port of Tacoma's Blair Waterway, Inner Hylebos, and Upper Hylebos properties (Figure 1-1) by Landau Associates, Inc. This plan addresses agency comments on draft work plans provided to the Port of Tacoma (Ecology letter dated October 27, 1989, EPA letter dated November 9, 1989 and as discussed at the November 14, 1989, meeting between Agencies, Port of Tacoma, and Puyallup Tribe of Indians (the Tribe).

The purpose of Phase II Environmental Investigations is to collect and analyze supplemental data (based on data gaps identified in the Phase I investigation) to further characterize environmental conditions at the properties. These supplemental data will be assessed and reported, in combination with data gathered during the Phase I investigation, in a Phase II assessment report to evaluate the need for any cleanup activities prior to transfer of the properties to the Tribe for industrial and commercial use.

The Phase II project objectives are:

- 1) Investigate ground water quality conditions in areas not previously monitored.
- 2) Identify marine sediment quality conditions with respect to potential remediation. (Data are not intended to address dredge disposal issues).
- 3) Investigate soil and onshore sediment quality conditions at locations identified in Phase I.

### 1.2 TASKS

The following tasks will be accomplished under the Phase II investigation scope of services:

#### Task 1: Project Management and Meetings

Task 1 includes project management activities, including day-to-day technical management of project activities to assure compliance with contractual requirements and technical scope. Also included under this task are two meetings to discuss progress, findings and conclusions, and technical approaches with the Port, and two meetings to make appropriate presentation of project results to the Tribe, local governments, or other parties to be determined by the Port. It is assumed that these meetings will require the presence of one or more principals and at least two to three additional project technical personnel of Landau Associates, Inc., and substantial preparation time (including the preparation of



presentation materials such as display boards, slides, overheads, video recordings, or other media for use in the latter two meetings).

#### Task 2: Mobilization

Task 2 includes mobilization of equipment, material, and personnel to the properties for Phase II investigations. Included in this task are activities associated with selection and contracting of subconsultants.

#### Task 3: Field Investigations

Task 3 includes field investigation activities summarized in Section 2.0 of this Work Plan. Specific field investigation procedures are described in Section 3.0.

#### Task 4: Chemical Analyses

Task 4 includes chemical analyses of samples collected under Task 3 and associated Quality Assurance/Quality Control. A description of laboratory methods and quantification limits is presented in Section 4.0 of this Work Plan; quality assurance and quality control (QA/QC) procedures are described in the Quality Assurance Project Plan, Appendix B.

#### Task 5: Reporting

Task 5 includes preparation of separate technical reports for each of the three properties being investigated. The final reports will present Phase II investigation results, evaluations, and recommendations for remediation of conditions with the potential to affect the commercial or industrial use of the three subject properties. Risk assessment and remedial design are not included as part of Phase II. Reporting requirements (standard units of measure) to be used are presented in Section 3.0 (field measurements) and Section 4.0 (chemical data as reported by laboratories).

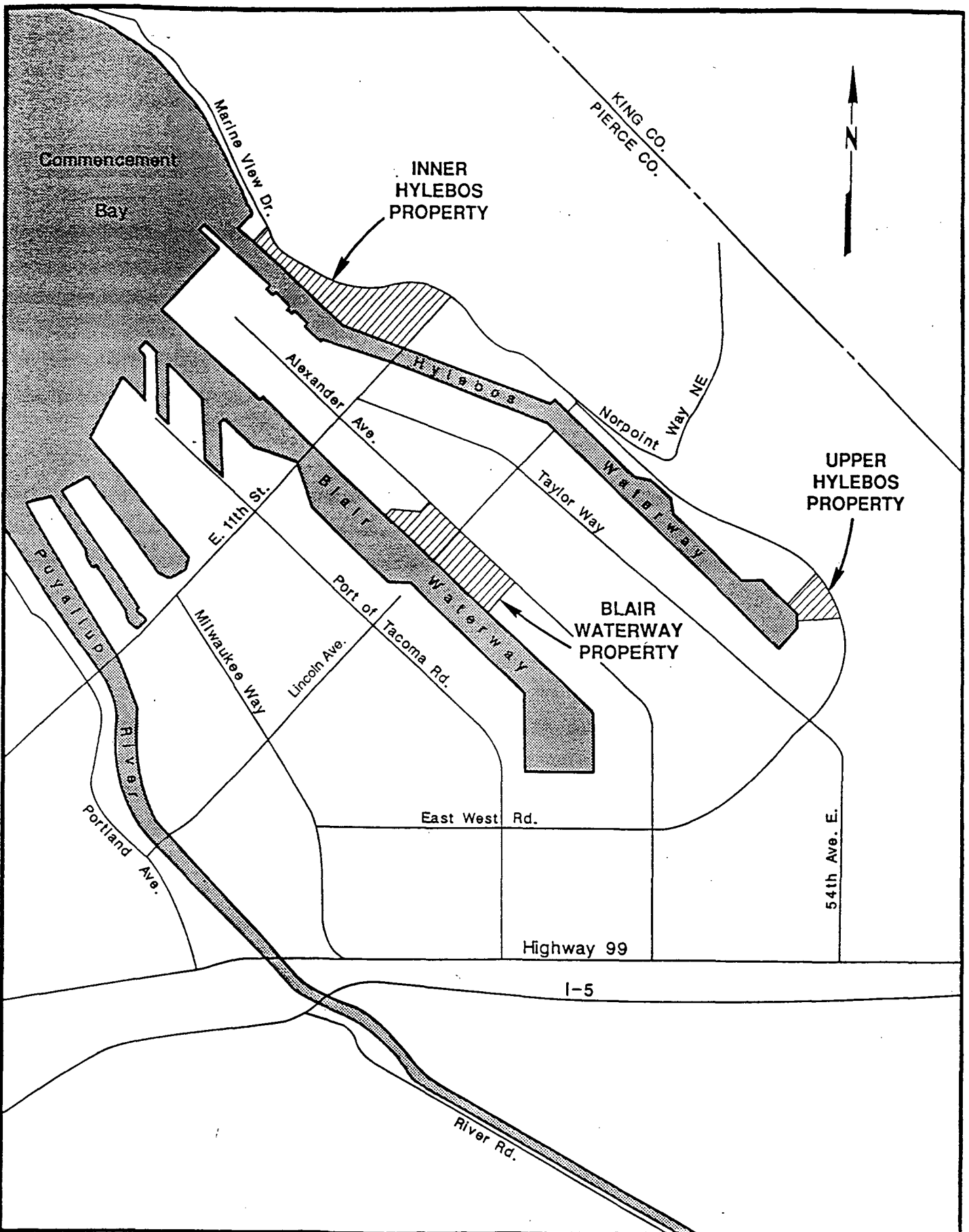
To assure the precision and comparability of reported data, laboratory data will be reported in units and to the limits presented in Section 4.0, and field measurements will be recorded and reported in the units and to the limits noted below:

- o pH, to 0.1 unit.
- o Temperature, to 0.5° F.
- o Specific conductivity, to  $\pm$  5 percent.
- o Water levels, to 0.01 feet.
- o Total well depth, to 0.5 feet.

- o Surveyed elevation, to 0.01 feet to the nearest permanently marked benchmark and referenced to National Geodetic Vertical Datum (NGVD).
- o Surveyed location, to the nearest 1.0 foot.

\* \* \* \* \*

The remainder of this Work Plan summarizes the technical scope of services to be conducted during sample collection and laboratory analyses of samples.



Source: Thomas Bros. Map, Pierce County,  
dated 1985.

LANDAU ASSOCIATES, INC.

Vicinity Map

## 2.0 SCOPE OF SERVICES

This section presents a description of the Phase II investigation activities to be accomplished at each of the three properties by Landau Associates, Inc. (Landau). The project schedule, which addresses field investigations, chemical analyses, and reporting, is shown on Figure 2-1. Sample collection and analyses are summarized in Table 2-1. Section 3 of this Work Plan presents the procedures and equipment to be used in accomplishing this scope of services, as well as sample handling and documentation procedures. Section 4.0 presents chemical analysis procedures to be used, including methods and quantification limits. Appendix A presents the project Health and Safety Plan. Appendix B presents the Quality Assurance Project Plan procedures to be applied during Phase II investigations.

### 2.1 BLAIR WATERWAY PROPERTY

Services to be conducted at the Blair Waterway property (Figure 2-2) include:

- o Installation and sampling of 19 ground water monitoring wells, 9 completed in the shallow aquifer, 6 in the intermediate aquifer, and 4 in the deep aquifer (Figure 2-2), to assess ground water quality conditions in previously uninvestigated portions of the property; these data will also be used to assess potential sources of contaminants. Ground water samples will be analyzed for priority pollutants plus p-tert-butylphenol, major cations and anions, and formaldehyde (see Section 4.1).
- o Data from the December 1989 sampling of Reichhold monitoring wells located on the Blair Waterway property will be evaluated, if available, along with ground water data resulting from Phase II investigations.
- o Collection of 4 sediment samples from the Lincoln Avenue Drainageway, and analysis for priority pollutants at random locations along the drainageway.
- o Collection of 12 sediment samples from the two boundary ditches (7 from the ditch adjacent to Domtar, 5 from the ditch adjacent to Weyerhaeuser), and analysis for total metals, volatiles, semi-volatiles, and PCBs. EP Toxicity metal analysis will be conducted on archived samples if metal concentrations are sufficiently elevated (see Section 4.2). Specific sampling locations will be chosen randomly.
- o Collection of 2 samples (1 sample each) of the orange and black precipitates in the northeast (Domtar) boundary ditch, and analysis for total metals and cations/anions.
- o Collection of 9 cored samples of Mud Lake sediments; each core will be composited and analyzed for semi-volatiles, to obtain a reliable mean and variation for concentrations within the sediments if Mud Lake investigation is included in this phase. Two additional samples (1 each) will be collected from the lake spillway and outfall. As shown in Table 2-1, these sediments will be analyzed for total metals, volatiles,

semi-volatiles, PCBs, and pesticides, with EP Toxicity metals testing only if total metal data warrant (see Section 4.2).

- o Collection of 3 core samples of subtidal marine sediments at each of two locations (Figure 2-2). Two depth strata within each core will be subsampled, and the depth strata subsamples will be composited across the three cores at each station. The four composite samples (two depth strata from the two stations) will then be analyzed for metals, volatile and semi-volatile organic compounds, PCBs, pesticides, and conventional parameters according to PSEP protocols and analyzed using PSDDA screening levels as quantification limits (Tetra Tech, 1986a,b,c) (see Section 4.3).
- o Collection of up to 5 soil samples along the railroad right-of-way and analysis for total metals, semi-volatiles, PCBs, and pesticides. Three samples (estimated) will be at random locations; two (estimated) will be in areas of visual staining.
- o Collection of 2 soil samples at the "outlet fill area" of the Lincoln Avenue Drainageway (Figure 2-1) and analysis for EP Toxicity metals.
- o Collection of 2 soil samples from the drum storage area (Figure 1-1), and analysis for PCBs, and volatile and semi-volatile organics.
- o Collection of 2 soil samples from the fuel area (Figure 2-2) and analysis for semi-volatiles. Samples will be vertically composited over the depth of staining.
- o Collection of up to 8 soil samples from test pit explorations at locations other than identified above with visual indication of contamination and analysis of samples for metals, semi-volatile organics, and PCBs. If locations of monitoring wells are compatible with planned soil sample sites, then samples collected during drilling activities may substitute for test pit samples.

## 2.2 INNER HYLEBOS PROPERTY

Investigations to be conducted at the Inner Hylebos property are summarized in Table 2-1 and shown on Figure 2-3. They include:

- o Installation and sampling of 1 monitoring well at the location shown on Figure 2-3, and analysis for volatiles and TPH to assess potential historical leakage from recently removed underground storage tanks located at the abandoned gas station which is located offsite to the east of the Port's property.
- o Collection of 2 sediment samples from the ditch just west of the abandoned gas station site, and analysis for volatiles and TPH to assess potential of leakage from underground storage tanks; specific sampling locations will be determined based on field observations.

- o Collection of 3 surface marine sediment samples at each of four intertidal<sup>1</sup> stations (IHS 1 to 4). At each of these four stations, the three surface samples will be composited and the resulting composite samples will be analyzed for metals, volatile and semi-volatile organic compounds, PCBs, pesticides, and several conventional parameters according to PSEP protocols (Tetra Tech, 1986a,b,c) (Section 4.3). In addition, three core samples of intertidal sediments will be collected at a single station (IHS 5). Three depth strata within these cores will be subsampled, and the depth strata subsamples will be composited across the three cores. These three composite samples will then be analyzed for the same parameters as the intertidal surface sediment samples.
- o Collection of 3 surface marine sediment samples at each of two subtidal stations (IHS 6 and 7). At each of these two stations, the three surface samples will be composited and the resulting composite samples will be analyzed for the same parameters as the intertidal sediment samples. In addition, three core samples of subtidal sediments will be collected at each of two stations (IHS 8 and 9) (Figure 2-3). Three depth strata within these cores will be subsampled, and the depth strata subsamples will be composited across the three cores. These six composite samples (three depth strata from each of two stations) will then be analyzed for the same parameters as the intertidal sediments.
- o Documentation and evaluation of refuse disposed of without authorization along those portions of the property adjacent to East 11th Street (Figure 2-3). An estimated four to six samples of underlying soil will be collected and analyzed for total metals, volatiles, semi-volatiles, and PCBs.
- o Collection of 1 sample of the water from seeps (Figure 2-3) and analysis for priority pollutants.
- o Collection of 1 sample of the precipitate associated with seeps shown on Figure 2-3, and analysis for total metals, and cations/anions to assess their physical and chemical properties.
- o Collection of up to 4 soil samples from test pit explorations at locations of visible surface staining or other indications of contamination and depths to be determined in the field, and analysis for total metals, semi-volatile organics, and PCBs.
- o Collection of 4 samples from sediments at the four largest of nine storm drain outfalls (Figure 2-3) and analysis for priority pollutants if storm drains are included in this investigation.

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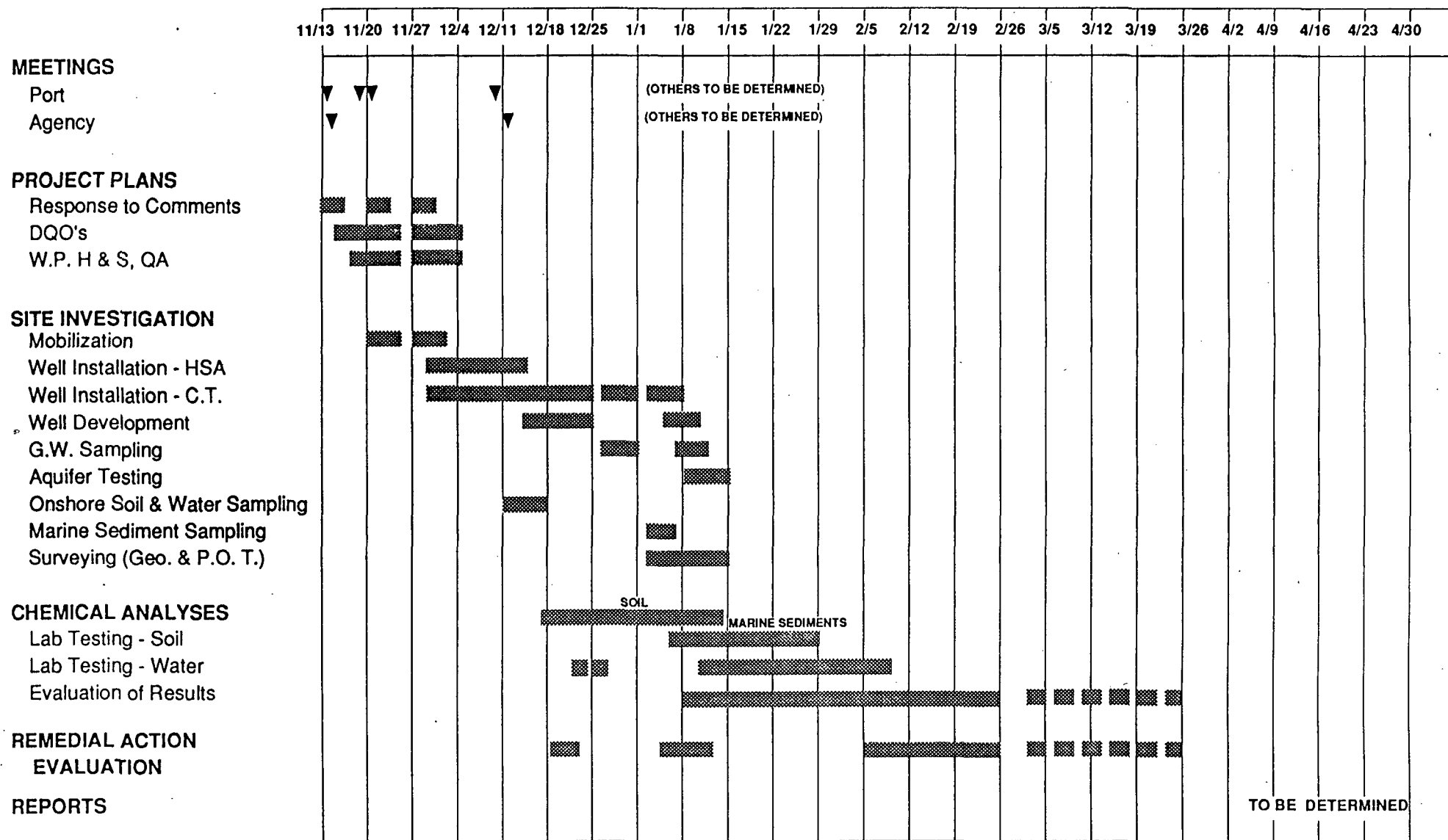
<sup>1</sup> Intertidal - pertaining to the shore zone bounded by the levels of high and low tides.

- o Geophysical investigation of Hylebos Waterway Peninsula (old mill site) to evaluate the possible presence of underground storage tanks.

### 2.3 UPPER HYLEBOS PROPERTY

Investigations to be conducted at the Upper Hylebos property are summarized in Table 2-1 and Figure 2-4. They include:

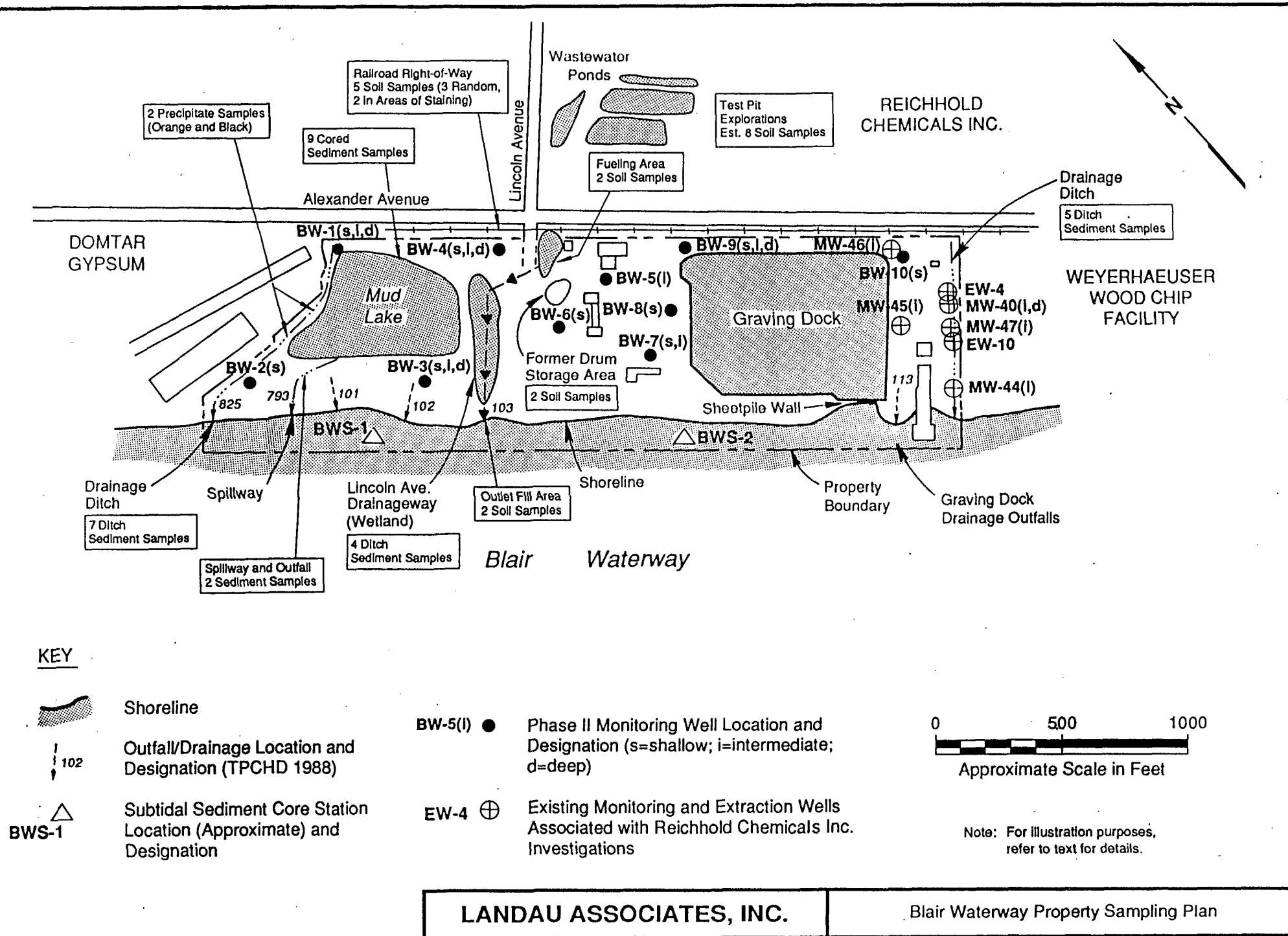
- o Collection of 2 sediment samples from the boundary ditch (Figure 2-4) at two randomly determined locations and analysis for priority pollutants; 1 additional sample will be archived for EP Toxicity metals analysis if total metals concentrations are sufficiently high (see Section 4.2).
- o Collection of 1 composite ground water sample from seeps depicted on Figure 2-4, and analysis for priority pollutants to assess possible upgradient contaminant sources.
- o Collection of 1 sediment sample from the bottom of the PVC standpipe in the north-east corner of the property (Figure 2-4), and analysis for total metals, volatiles, semi-volatiles, and PCBs to assess water quality and potential for past waste disposal practices contributing to property contamination.
- o Collection of up to 5 samples of soil along railroad right-of-way (Figure 2-4), 3 (estimated) at random locations and 2 (estimated) in areas of visible staining, with analysis for total metals, semi-volatiles, pesticides, and PCBs.
- o Collection of surface marine sediment samples at each of two subtidal stations (Figure 2-4). At each of these two stations, three surface samples will be composited and the two resulting composite samples will be analyzed for metals, volatile and semi-volatile organic compounds, PCBs, pesticides, and conventional parameters according to PSEP protocols (Tetra Tech, 1986a,b,c) (see Section 4.3).
- o Collection of up to 4 soil samples from shallow test pit explorations at locations of visible surface staining or other indication of contamination (anticipated depths 0.5 to 5 feet), and analysis for total metals, semi-volatile organics, and PCBs.

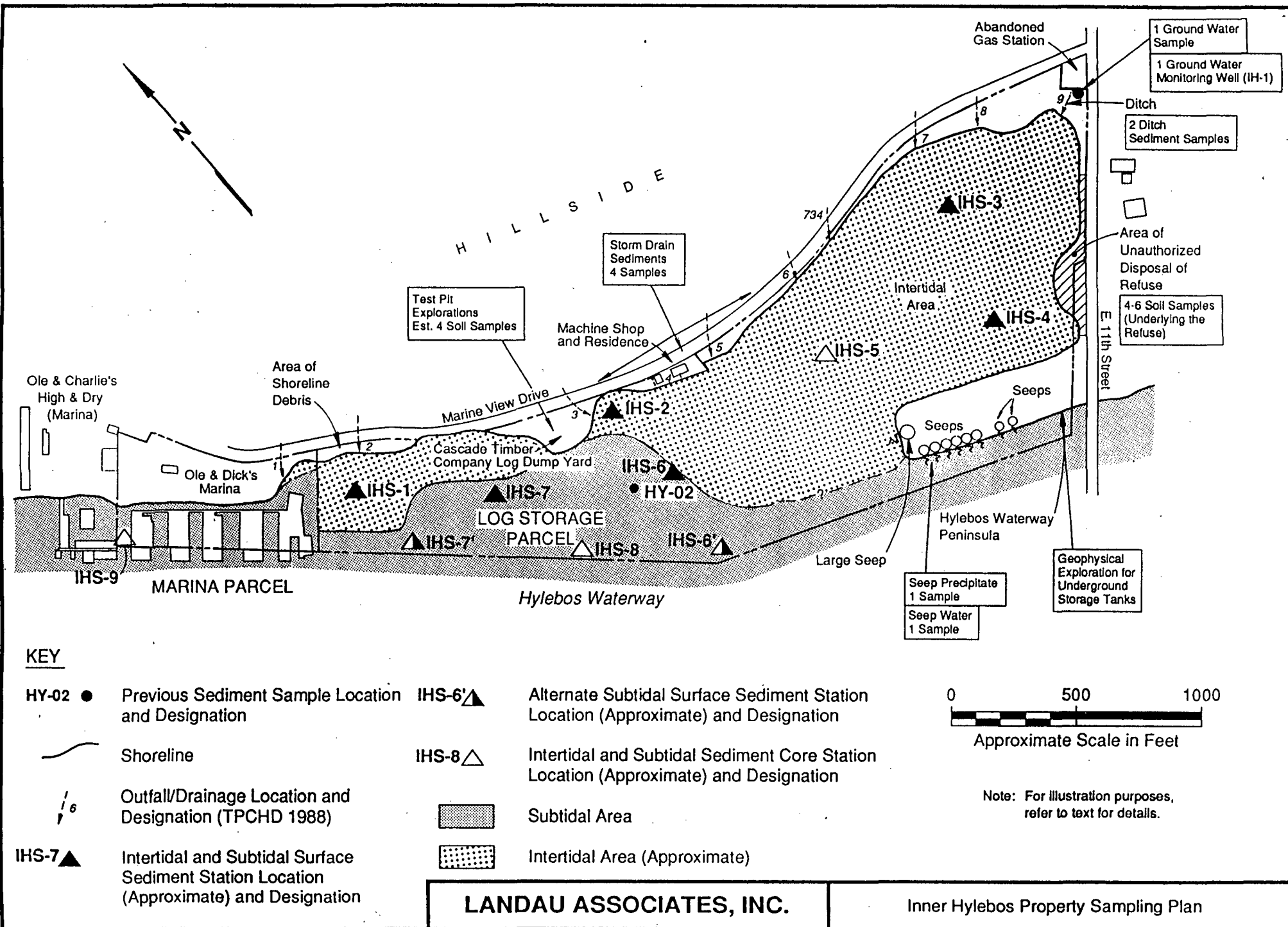


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Planned Schedule







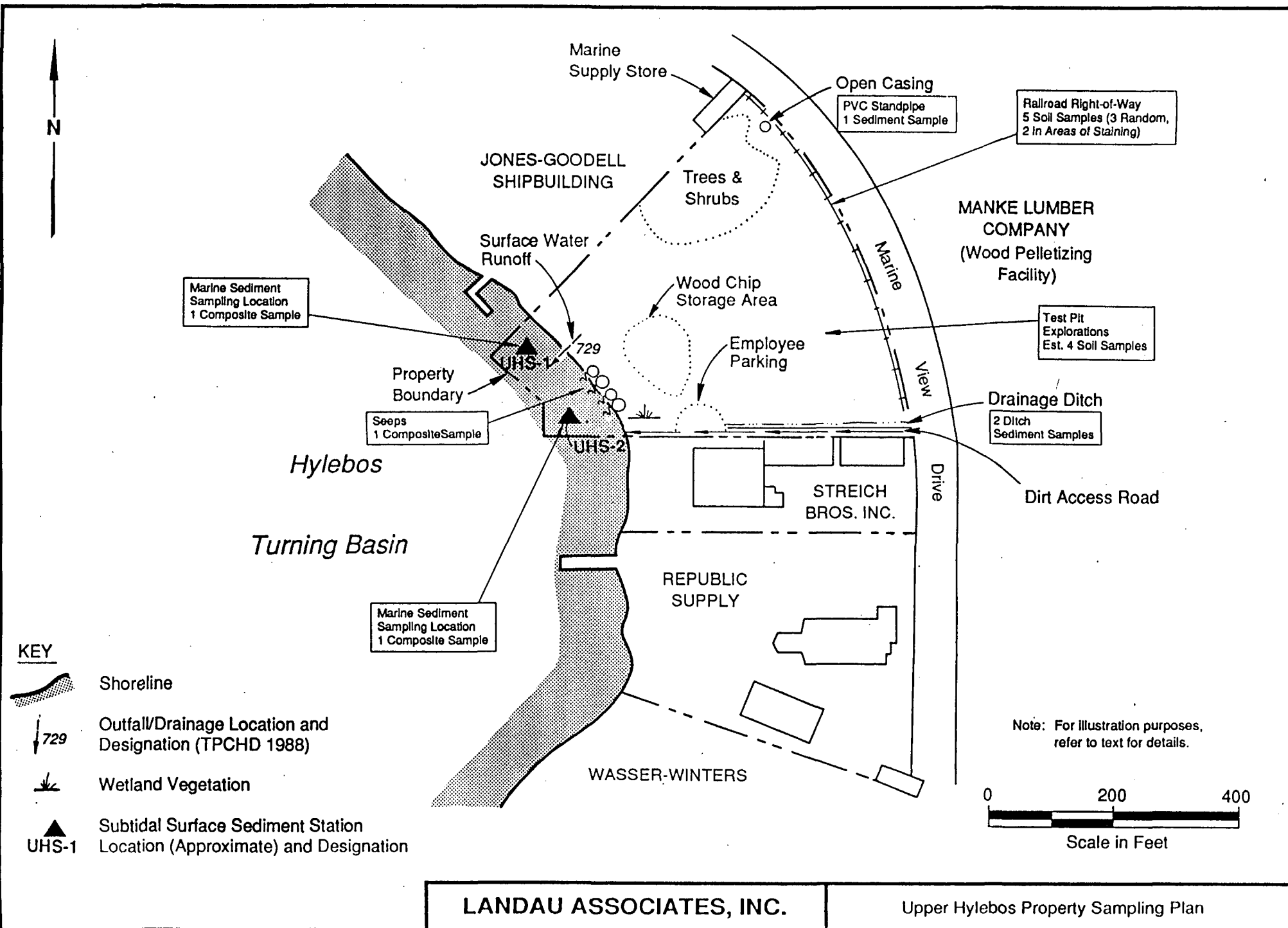


TABLE 2-1  
SAMPLE COLLECTION AND ANALYSES SUMMARY -- PHASE II ENVIRONMENTAL INVESTIGATION

Property/Matrix	No. of Samples	Analytical Parameters									
		Total	Dissolved	EP Tox	Semi-		Pesti-	Formal-	Cations/	TPH	
		Metals	Metals	Metals	Volatiles	Volatiles	PCBs	cides	dehyde	Anions	
BLAIR WATERWAY PROPERTY											
Ground Water (Wells)	19		x		x	x	x	x	x	x(a)	
Sediment											
- Lincoln Ave. Ditch	4	x		x(b)	x	x	x	x			
- Boundary Ditches	12	x		x(b)	x	x	x				
- Mud Lake	9(f)					x					
- Outfall and Spillway	2	x		x(b)	x	x	x	x			
- Marine (c)	4										x
Surface Soil											
- Outlet Fill Area	2			x							
- Drum Storage Area	2				x	x	x				
- Test Pits	8(est)	x				x	x				
- Fueling Area	2					x					x
- Railroad Spur	5(est)	x				x	x	x			
Ditch Precipitates	2	x								x(d)	
INNER HYLEBOS PROPERTY											
Ground Water	1				x						x
Sediment											
- Gas Station Ditch	2				x						x
- Marine (c)	15										x
- Storm Drains	4(f)	x			x	x	x	x			
Seep Precipitate	1	x								x(d)	
Hylebos Waterway											
Peninsula (e)											
Surface Soil											
- Test Pits	4(est)	x				x	x				
- Underlying the Refuse	6(est)	x			x	x	x				
Seep Water	1		x		x	x	x	x			
UPPER HYLEBOS PROPERTY											
Ground Water (Seep)	1		x		x	x	x	x			
Sediment											
- Boundary Ditch	2	x		x(b)	x	x	x	x			
- PVC Standpipe	1	x			x	x	x				
- Marine (c)	2										x
Surface Soil											
- Railroad Right-of-Way	5(est)	x				x	x	x			
- Test Pits	4(est)	x				x	x				
TOTAL ANALYSES	120	60	21	22	57	91	80	43	19	28	5 21

(a) Selected samples only (see Section 4.1).

(b) If total metals are sufficiently elevated to warrant EP Toxicity metal analysis for DW designation (see Section 4.2).

(c) Marine sediments will be analyzed for chemicals having screening levels (SL) defined by PSDDA and for conventional parameters (see Section 4.3).

(d) Precipitate samples will be analyzed for metals as well as aluminum, calcium, chloride, magnesium, and sulfide.

(e) The potential for underground storage tanks at the old mill site on the Peninsula will be investigated using geophysical methods

(f) Sample and tests if Mud Lake and storm drains are included in this phase.

### 3.0 SAMPLING EQUIPMENT AND PROCEDURES

This section presents the sampling equipment and procedures to be used in the field during the Port of Tacoma Phase II Environmental Investigations. The procedures herein are presented by sample matrix (ground water, surface water, soil and ditch sediments, and marine sediments), and are to be used when collecting and handling samples on any of the three properties where investigations of the indicated matrix are being conducted.

#### 3.1 GROUND WATER INVESTIGATIONS

##### 3.1.1 Monitoring Well Program

Ground water monitoring wells will be installed at the Blair Waterway and the Inner Hylebos properties only.

- o Blair Waterway Property: A total of 19 wells (9 screened in the shallow aquifer, 6 screened in the intermediate aquifer, and 4 screened in the deep aquifer) will be installed at locations shown on Figure 2-2.
- o Inner Hylebos Property: One well (screened in the shallow aquifer) will be installed at the location shown on Figure 2-3.

Well design, installation, and development will be in accordance with procedures outlined in the following sections.

#### MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT

##### Well Design

Typical monitoring well designs for shallow, intermediate, and deep wells are shown on Figures 3-1 and 3-2, respectively. Wells in the shallow aquifer will be constructed with the screens extending across the top of the zone of saturation. A variance has been obtained from Ecology as required by WAC 173-160 for construction of shallow wells (Ecology letter dated November 29, 1989). Wells in the intermediate and deep aquifers will be constructed with the screens placed just below the bottom of the confining aquitard. Well screens in the shallow aquifer will not be greater than 10 feet in length; those in the intermediate and deep aquifers will not be greater than 5 feet in length.

### Well Construction

Borings for the new monitoring wells will be drilled using cable tool (intermediate and deep) or hollow-stem auger (shallow) methods. As shown on Figure 3-2, the temporary steel casing size will be reduced (stepped down) when crossing an aquitard. The annulus between the temporary steel casings will be filled with Volclay grout to prevent aquifer cross contamination. It is anticipated that the casing sizes used will be 12-inch, 8-inch, and 6-inch for deep wells, and 8-inch and 6-inch for intermediate wells. Samples will be collected for geologic record purposes at a minimum of 5-foot intervals, or at shorter intervals as required by the field geologist.

Prior to and after drilling, the drilling derrick and all temporary steel casing and downhole equipment will be cleaned using a high-pressure hot water washer, as required by WAC 173-160-530. Prior to installation of the wells, all casing centralizers and screen will be similarly cleaned and inspected for damage.

A geologist or engineer will direct drilling and well installation. A record of the soil and ground water conditions will be maintained during drilling on a form such as Figure B-2. In the event that zones of subsurface contamination (identified visually or by monitoring) are encountered during drilling, samples of the contaminated interval will be obtained for analysis using a clean 2.42-inch inside diameter (ID) split-barrel sampler. Sampling equipment decontamination is addressed in Section 3.2 below. Any soil samples collected for analysis will be placed in glass soil sampling jars with teflon-lined lids.

The well casing will be installed to the target depth through the temporary casing or the augers. A stainless steel centralizing device will be installed in the vicinity of intermediate and deep well screens. Once the well casing and the screen are installed, the total length of the well will be verified and documented by lowering a weighted tape to the bottom of the inside of the well. Well alignment will be determined by lowering a 3-foot long, 1.5-inch outside diameter (OD) or larger bailer into the well.

A filter pack will be installed around the screen, extending from the bottom of the borehole to approximately 3 feet above the screen, except for shallow wells as noted above. Filter pack material will be commercially prepared pre-sized, pre-washed No. 10-20 Colorado silica sand. A 1 to 2 foot layer of fine sand (No. 20-40 or finer) will be placed above the sandpack in intermediate and deep wells where a high solids bentonite grout seal is planned. The filter pack will be installed through a tremie pipe or carefully poured down the annulus between the well casing and the temporary casing, as the temporary casing is slowly withdrawn. During filter pack placement, the distribution and depth of the filter pack will be monitored with a weighted tape.

Bentonite pellets will be placed above the filter pack to provide a near-surface borehole seal in shallow wells. Pellets will be allowed to hydrate for at least 30 minutes prior to completing well construction. The borehole annulus for intermediate and deep wells will be sealed using a high-solids bentonite grout (American Colloid Pure Gold grout). The annular space grout seal will be installed to at least 5 feet below the ground surface using a tremie pipe. The tremie pipe will be sealed at the lower end and have side discharges to prevent grout getting into the sandpack. Pure Gold grout will be mixed to a density of at least 10.2 pounds per gallon (American Colloid density specification) and checked in the field using a mud balance. Alternatively, instead of using Pure Gold grout, the annulus seal for intermediate and deep wells may be constructed using a bentonite pellet seal of at least 3 feet in thickness with Volclay grout or bentonite chips installed above the pellet seal. The surface of the intermediate and deep wells will be finished using bentonite chips (as required) and a concrete surface seal. Locking steel monuments will be cemented in place at the surface and a concrete pad will be constructed around each well at ground surface to divert rainfall away from the well casing. In accordance with WAC 173-160, to further prevent damage to the wells by large equipment, three steel pipes will be cemented in place around each wellhead. Each wellhead elevation (top of casing and ground surface) and location will be surveyed.

#### RESIDUALS MANAGEMENT

Residual soil cuttings and water generated from drilling activities and water purged from wells during development and sampling will be contained in steel barrels as shown in Table 3-1.

#### WELL DEVELOPMENT

After the final grout has set in the well annulus for a minimum of 12 hours, the well will be developed to remove sediment introduced during installation activities, and to establish hydraulic continuity between the filter pack and the formation. It is anticipated that development will be accomplished by purging using a development pump. No surging of the water in the well is planned to keep turbidity associated with nearby silt and clay to a minimum. Development will continue until the wells are visibly free of sediments and the turbidity of discharged water is low. Development water will be contained in barrels as indicated in Table 3-1.

## HYDRAULIC CONDUCTIVITY TESTING

As agreed during the November 14, 1989, meeting with EPA, Ecology, Port, and Tribe representatives, variable head (rising or falling head) tests will be conducted to permit estimates of hydraulic conductivity conditions. Variable head tests are planned for four well groups (BW-1, 3, 4, and 9) at the Blair Waterway Property (Figure 2-2). Variable head tests will be conducted following development and sampling. The method used will depend on ground water depth measurements, rate of recharge, and well depth information collected during drilling and development. A stainless steel slug may be used to induce head change on slow or moderate recharge wells, and an introduced "slug" of water may be used for falling head wells with moderate to high soil permeability and confined conditions. If a slug of water is introduced, the water will be clean drinking water and the well will be purged of at least 3 well volumes following testing.

## MONITORING WELL SAMPLING AND SAMPLE HANDLING

Each new monitoring well will be sampled once during Phase II investigations and analyzed for parameters identified in Table 2-1 which include the chemical constituents known to contaminate ground water upgradient of the site. Sample collection and analytical procedures that will be followed are outlined below.

### Sample Collection

Water levels in all wells will be measured prior to initiation of each sampling event. Water levels will be obtained using an electronic water level indicator. Measurements will be recorded to the nearest 0.01 foot, from a clearly marked survey point on the well casing.

Following measurement of water levels, each well will be checked for the presence of an immiscible layer using clean lucite bailers or electronic product probes. If a separate phase is found, it will be collected as a separate sample and analyzed for volatile and semi-volatile organics.

To aid in collecting representative ground water during sampling, each well will be purged using a centrifugal pump or a bladder pump prior to sampling. Purging will continue until at least three well volumes have been removed and specific conductivity has stabilized (repeat sample measurements vary by no more than 10 percent). If the well is purged dry, purging will be considered complete. Sampling for volatile organics will commence as soon as sufficient volume is available to sample.



Samples will be collected in the appropriate container (Table 3-2) using a stainless steel bailer, peristaltic pump (for metals only), or a bladder pump immediately following purging. The sample container will be cleaned to EPA specifications prior to use. The order of sample collection will be:

- o Volatile organic analyses (VOAs)
- o Semi-volatile (extractable) organics, including p-tert-butylphenol
- o Formaldehyde
- o PCBs and pesticides
- o Metals
- o Cations and anions
- o Field parameters

Containers will be filled directly from the pump outlet or bailer discharge; metals samples will be filtered through a 0.45-micron in-line filter. Volatile organics sample containers will be filled with no headspace remaining. If air bubbles are observed, the container will be emptied and refilled or a new container used; air bubbles will be excluded. Samples will be preserved as specified in Table 3-2.

#### Sample Documentation and Handling

The site monitoring well and other relevant information or field activities will be documented in the field on appropriate forms (see Appendix B, Section 4.0) and in bound field notebooks at the time of sampling. In addition, each sample container will be labeled and recorded on a Chain-of-Custody Record (Figure B-5 in Appendix B). A Sample Collection Form (Figure B-3 in Appendix B) will be completed at the time the sample is collected to document the sample. Sample labels (Figure B-4 in Appendix B) which will be completed and affixed to each sample container, will identify sampling personnel, the project name, the sample number (which is composed of an alphanumeric sample identifier and an alphabetic container code), location, and the date and time of collection. The chain-of-custody record will follow the sample from collection through transfer, analysis, and disposal. This procedure is designed to maintain the integrity of the sample as well as to properly account for the sample at all stages through disposal.

Samples will be placed on sealed, reusable ice packs or double-bagged ice. At the end of the day, samples will be inventoried and the coolers will be sealed with tape and a custody seal, and labeled for transport. Samples will be transported to the laboratory within 24 hours.

When transferring samples, the individuals relinquishing and receiving the samples will sign and date the chain-of-custody record. The chain-of-custody record will accompany each shipment. Custody seals are not deemed necessary when the samples are in continuous possession of technical or laboratory personnel. Custody seals will be used if samples will be shipped via courier service, and the method of shipment, courier name, and other pertinent shipping information will be entered in the chain-of-custody record.

A note will be made on the Sample Label and on the Sample Analysis Request Packing List to indicate the ground water sample has been field-filtered. Analytical methods for analysis of ground water samples will be EPA-approved methods (see Section 4.1).

### EQUIPMENT DECONTAMINATION

Appropriate decontamination procedures for ground water sampling equipment will be employed to minimize the possibility of cross-contaminating samples. Sampling equipment that comes into contact with potentially contaminated soil or water will be decontaminated prior to and after each use. Decontamination of sampling equipment will consist of the following steps:

- o Spray or scrub off soiled equipment
- o Wash with Alconox soap
- o Rinse with DI/distilled water

Decontamination of drilling equipment has been addressed in Section 3.1 above.

### **3.1.2 Seep Sampling Program**

#### SAMPLE COLLECTION

Collection of ground water seep samples (planned only at the Upper Hylebos property) will be performed in accordance with the procedures below. It is planned that sampling will be conducted when tidal conditions permit suitable shoreline exposure.

Ground water will be collected from representative seeps by one of two methods:

- o A length of clean stainless steel or PVC pipe will be positioned against the point of emergence of the spring or seep with the downstream end of the pipe braced sufficiently above the grade to allow a sample bottle to be placed under the pipe. Water will be diverted through the clean pipe and collected at the discharge once flow has become clear of sediment.
- o Using a clean shovel, a small pit will be excavated at the base of the seep or spring. After all sediment has settled and the water has become clear, samples will be collected by submerging the sample container into the clean pool.

Where appropriate (where multiple seeps are located in a limited area) samples will be composited at the discretion of the field technician.

Conductivity and pH meters will be calibrated, following procedures provided with the instrument, prior to sampling each site or at least once every four hours of sampling. Calibration adjustments will be recorded in a log book maintained for each meter. After each sample is collected, the calibration will be checked by measuring the pH 7 buffer solution and recording that reading and the buffer temperature in the Sample Collection Form. Calibration procedure will be repeated if pH is greater than 0.1 unit or conductivity is greater than 5 percent different than calibration standard.

Four replicate field measurements of pH and conductivity will be made using the following procedures:

- o Rinse a 250 ml plastic beaker three times with water.
- o Rinse the electrode, dip cell, and temperature compensation probe by storing them in sample water for at least one minute.
- o Set the automatic temperature compensator to the "on" position.
- o Fill the beaker with sample water; set the probes in the beaker until the reading stabilizes. Read temperature, pH, and conductivity measurements and record on the Sample Collection Form.
- o Measure and record three additional sample replicates by repeating this last step.
- o Note any problems or significant observations in the "comments" section of the Sample Collection Form.

Sample containers that have been cleaned to EPA specifications will be obtained from the analytical laboratory with the proper preservatives in the appropriate containers. The volatile organics sample containers will be filled with no headspace remaining, and air bubbles will be excluded. All other bottles will be filled to the top. Water for metals analysis will be filtered through a 0.45-micron disposable filter.

#### **SAMPLE HANDLING AND EQUIPMENT DECONTAMINATION**

A note will be made on the Sample Label and on the Sample Analysis Request Packing List to indicate the ground water sample from the seep has been field-filtered. All other sample handling and equipment decontamination procedures for seep samples will be identical to those specified for monitoring well ground water samples in Section 3.1.1.

### 3.2 SURFACE SOIL, ONSHORE SEDIMENT, AND PRECIPITATE SAMPLING PROCEDURES

Surface soil samples will be collected as identified in Table 2-1. These include the drum storage area, the outlet fill area, the fueling area, the railroad right-of-way, and test pits at the Blair Waterway property, test pits and soil under refuse discarded on the Inner Hylebos property along East 11th Street, and test pits along the railroad right-of-way at the Upper Hylebos property. Onshore sediment and precipitates will be sampled at the Blair Waterway (Mud Lake and its outfall and spillway and the Lincoln and boundary ditches), Inner Hylebos (gas station ditch), and Upper Hylebos (PVC standpipe sediments, ditch sediments) properties. Specific sampling locations will either be selected based on field conditions or will be random (see Section 2.0).

#### 3.2.1 Sampling

##### SOIL AND DITCH SEDIMENT

Soil samples will be taken from either the surface or from sidewalls and/or bottom of backhoe test pit explorations. Ditch sediment samples will be taken primarily from the upper foot of sediments. Soil and ditch sediment samples to be analyzed for volatiles will be collected and immediately placed in a small (4 oz.) jar for transport. The sample will be collected from the surface of the sampled area with a clean stainless steel spoon or spatula. Sample bottles for volatile organic analysis will be completely filled, and the glass rim will be cleaned with clean, unscented, undyed tissue paper before tightening the lid. There must be no grit between the rim and cap liner.

Samples for other chemical analyses will be placed into a large stainless steel bowl and will be thoroughly homogenized (composited). Samples to be analyzed for total metals and EP Toxicity metals will be placed in large sample jars for transport. Containers, preservation, and holding times for soil and ditch sediment samples are presented in Table 3-3. Archived samples will be retained in labeled, one-quart ziplock plastic bags and placed in labeled 5-gallon buckets, as appropriate.

##### MUD LAKE SEDIMENTS - BLAIR WATERWAY

If Mud Lake is included in this phase, samples of sediment will be collected using either a steel hand auger or a stainless steel tube sampler, depending on the moisture content and texture of the sediments. A core will be obtained at each sampling location and the material composited with a stainless steel trowel on a Teflon-lined or stainless steel tray. After thorough homogenization of the sample, sample jars will be filled and placed in coolers.

### SEDIMENT FROM BOTTOM OF OPEN CASING (PVC STANDPIPE) - UPPER HYLEBOS

Sediment in the bottom of the PVC standpipe at the Upper Hylebos property will be sampled by first removing the overlying water in the casing, either by pumping or bailing. In the event that pumping is impractical, bailing will be conducted with a precleaned bucket so as not to introduce additional contaminants into the standpipe. If necessary, the bucket will be lowered to the bottom on a nylon rope. All water removed from the standpipe will be collected in a drum and added to the other waste water generated on the site for proper disposal. It should not be necessary to remove all of the water overlying the sediment, but only enough to allow access to the sediment with a corer.

A sediment core of approximately 1-foot depth will be collected by manually inserting a precleaned stainless steel or PVC coring tube into the sediment, capping the open end, and removing the tube with the sediment retained inside. In the event that the sediment is so compacted that it is not possible to insert a coring tube manually, an auger will be used to collect the sediment. If insufficient sediment is collected in a single core for analysis, additional cores will be collected as needed.

The sediment collected will be composited and mixed manually in a precleaned, stainless steel bowl using a precleaned stainless steel trowel or spoon. A sediment sample will be collected from the sediment mixed in the bowl for chemical analyses.

### PRECIPITATE ASSOCIATED WITH SEEPS AND DRAINAGEWAYS - BLAIR WATERWAY/UPPER HYLEBOS

Seep and drainageway precipitate samples will be lifted from the sediments using a stainless steel spatula and transferred to a 4 oz. glass jar. Care will be taken to minimize the amount of sediment collected with the precipitate.

#### **3.2.2 Sample Handling and Documentation**

Each sample bottle will be identified with a unique sample number and logged on a Sample Collection Form. Handling and documentation procedures for surface soil and onshore ditch sediment samples will be identical to those for ground water samples (see Appendix B).

#### **3.2.3 Equipment Decontamination**

Soil sampling equipment will be decontaminated by scrubbing with a brush using a solution of drinking water and Alconox. The water will be changed if it becomes muddy or obviously contaminated. Therefore, an extra 10 to 15 gallons of clean water will be kept on-hand. The equipment will then be rinsed with drinking water. Rinsing will be performed by pouring clean water over the equipment until all soapy residue is removed. This rinse

will be followed by rinsing with distilled water (commercial grade). This will be performed by pouring distilled water over the equipment.

### 3.3 SUBTIDAL AND INTERTIDAL MARINE SEDIMENT INVESTIGATIONS

Subtidal sediment samples will be collected for analysis at all three properties; intertidal sediment samples will also be collected at the Inner Hylebos Waterway property. Due to the variability of the sediment sampling requirements at each of the properties, the marine sediment sampling program is discussed in this Work Plan by property. Sample depths are expressed in metric measurements to reflect the same units of measurement used in the Commencement Bay RI/FS studies. Subtidal sediment sample locations will be identified on large-scale navigational charts of the area at the time of sample equipment deployment. Intertidal sample sites will be located as above or by using survey equipment if practicable.

#### 3.3.1 Sample Collection

Collection of sediment samples at all locations will be in accordance with methods recommended in the Puget Sound Estuary Program (PSEP) protocols (Tetra Tech, 1986a,b,c). A more detailed discussion of sample collection procedures will be presented in a work plan prepared by the marine sediment contractor, if appropriate.

#### BLAIR WATERWAY PROPERTY

A summary of the marine sediment sampling program is presented in Table 3-4. At Stations BWS1 and BWS2 (see Figure 2-2), subtidal sediment samples will be collected in three cores at each station using a gravity corer (if possible) to a depth of approximately 3 feet. The subsamples taken from the cores will be:

- |                |  |
|----------------|--|
| 0-88 cm depth  | (composited, then subsampled; representative of a potential dredging depth)          |
| 88-90 cm depth | (a discrete sample to assess whether contaminant concentrations are near background) |

Subsamples from the same strata in the three cores from each station will be composited in the field. Table 3-5 presents the containers, preservation methods, and holding times for marine sediment samples.

## INNER HYLEBOS WATERWAY PROPERTY

### Subtidal Stations

A summary of the marine sediment sampling program is presented in Table 3-4. At Stations IHS 8 and 9 (see Figure 2-3), sediment samples will be collected in three cores at each station using a gravity corer (if possible) to a depth of approximately 90 cm. The sediment subsamples taken from the core will be:

- |                |   |
|----------------|---|
| 0-2 cm depth   | (for comparison with most of the other surface sediment data in the Commencement Bay RI/FS) |
| 2-88 cm depth  | (composited, then subsampled; representative of a potential dredging depth)                 |
| 88-90 cm depth | (a discrete sample to assess whether contaminant concentrations are near background)        |

Subsamples from the same strata in the three cores at each station will be composited in the field.

At Stations IHS 6 and 7 (assuming approach by boat is possible among the pilings shown on nautical charts of the area; if not, at Stations 6' and 7'), sediment will be collected using a 0.1-m<sup>2</sup> or 0.06-m<sup>2</sup> van Veen grab. Three replicate grabs will be collected at each station. Sediment samples will be removed from the uppermost 2 cm and away from the sides of the grab, and the samples from the three grabs at each station will be composited.

### Intertidal Stations

At Stations IHS 1 through 4, sediment will be collected in a hand-operated corer. Three replicate cores will be collected at each station, randomly located within a circle of approximately 50 feet diameter. The uppermost 2 cm of the sediments in each core will be removed and these samples from the three cores will be composited. At Station IHS 5, sediment will be collected in three cores using a hand-operated corer to a depth of approximately 3 feet. The subsamples taken from the core will be from the same intervals as in the subtidal core:

- 0-2 cm depth
- 2-88 cm depth (composited)
- 88-90 cm depth

Subsamples from the same strata in the three cores will be composited in the field.

Cautionary Note: Because all of the intertidal area at this property has been used for log storage, an attempt will be made to take intertidal core samples from areas free of excessive wood waste (bark, etc.). Similarly, if the subtidal sediment samples have a lot of

wood waste at the surface, the core or grab will be repeated in an attempt to collect a sample free of such material.

#### UPPER HYLEBOS WATERWAY PROPERTY

A summary of the marine sediment sampling program is presented in Table 3-4. At Stations UH 1 and 2 (see Figure 2-4), subtidal sediment will be collected using a 0.1-m<sup>2</sup> or a 0.06-m<sup>2</sup> van Veen grab. Three replicate grabs will be collected at each station. Sediment samples will be removed from the uppermost 2 cm and away from the sides of the grab, and the samples from the three grabs at each station will be composited.

#### **3.3.2 Sample Handling and Documentation**

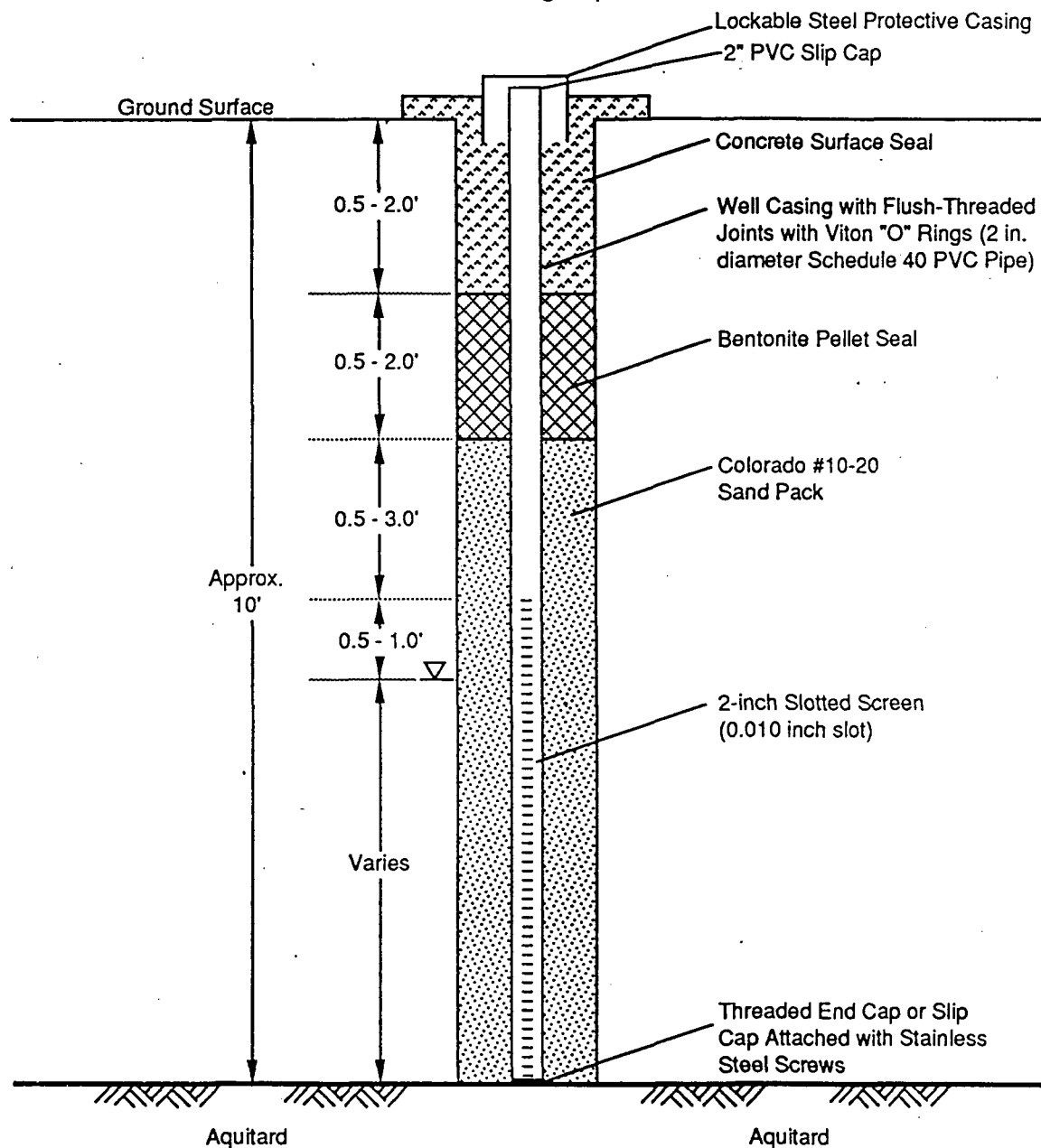
Each sample bottle will be identified with a unique sample number and logged on a Sample Collection Form. Handling and documentation procedures for marine sediment samples will be identical to those for surface soil and onshore ditch sediment samples.

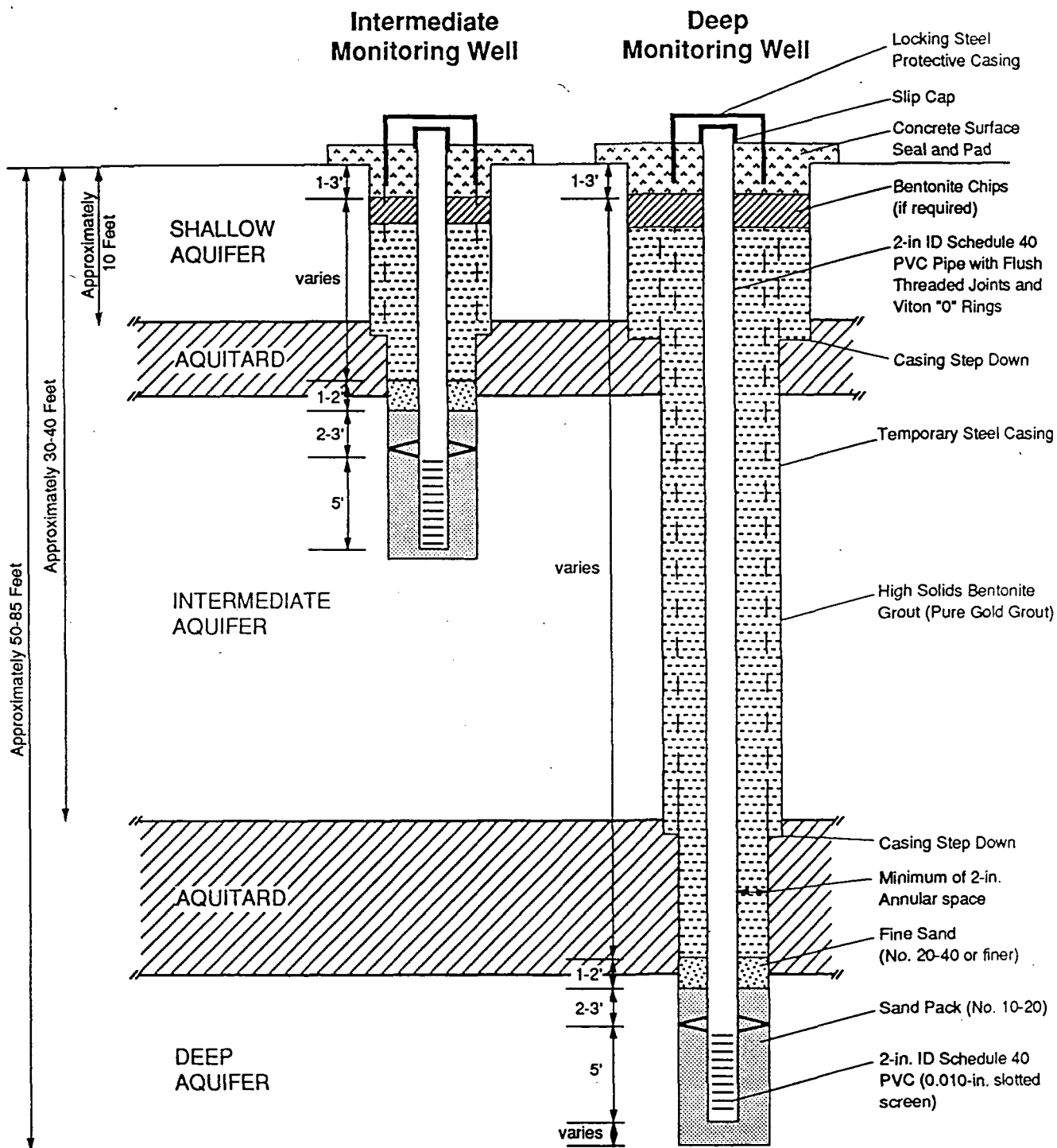
#### **3.3.3 Equipment Decontamination**

Sediment sampling equipment will be decontaminated by scrubbing with a brush using a solution of clean water and Alconox. The equipment will then be rinsed with drinking water poured over the equipment until all soapy residue is removed. This rinse will be followed by rinsing with deionized water poured over the equipment.



## Shallow Monitoring Well





Note: "Aquifer" designation in accordance with previous studies. Data suggest that aquitards are discontinuous, thus "aquifers" may be "zones" within a single aquifer.

TABLE 3-1

## RESIDUALS MANAGEMENT

Activity	Disposition of Residuals
Drilling and monitoring well construction	Soil cuttings and water will be contained in barrels
Monitoring well development	Development water will be contained in barrels
Ground water sampling	Purge water will be contained in barrels
Shallow soil sampling/backhoe explorations	Soil returned to exploration
Mud Lake sample residuals	Sediment returned to Mud Lake
Equipment washdown (drill rigs, etc.)	Water discharged to ground
<hr/>	
Management of drummed materials	Drums collected at designated control area near Graving Dock.
	Port's waste management subcontractor will supervise disposition of drummed materials.
	Port's intent is that material disposal will be in compliance with applicable Federal and State hazardous and solid waste regulations.

TABLE 3-2

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES  
GROUND WATER SAMPLES

Bottle Code	Analyses	Sample Container	Preservation	Maximum Holding Time(a)
V	Volatile Organics	2 ea. - 40 ml glass vials; Teflon-lined cap	No headspace; Cool to 4 deg.C	7 days
E	Semi-volatile Organics, Pesticides, and PCBs	80-oz. amber glass, Teflon- lined cap	Cool to 4 deg.C	7 days to extract; 40 days after extraction
F	Formaldehyde	1000 ml amber glass, Teflon- lined cap	Cool to 4 deg.C	14 days
M	Dissolved(b) Cations and Metals	16-oz. Poly- ethylene	Filter (0.45 micron); acidify with HNO <sub>3</sub> to pH <2	6 months
A	Anions(c)	Polyethylene	Cool to 4 deg.C	28 days
C	Alkalinity	Polyethylene	Cool to 4 deg.C	14 days
T	Total Petroleum Hydrocarbons	1000 ml amber glass, Teflon- lined cap	Cool to 4 deg.C HCl to pH <2	14 days

(a) Holding times are from date of collection. All samples will be delivered to the laboratory within 24 hours.

(b) Includes: antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, thallium, and Zinc. Selected samples will also include: aluminum, calcium, magnesium, potassium, and sodium.

(c) Includes: chloride and sulfate.

TABLE 3-3

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES  
SURFACE SOIL AND ONSHORE SEDIMENT SAMPLES

Bottle Code	Analyses	Sample Container	Preservation	Maximum Holding Time(a)
M	Metals(b)	16-oz wide mouth plastic	Cool to 4 deg.C	6 months
V	Volatiles	60 ml glass jar (little or no headspace)	Cool to 4 deg.C	7 days
E	Semi- volatiles, Pesticides, and PCBs	16-oz wide mouth glass jar	Cool to 4 deg.C	14 days until extraction; 40 days after extraction
T	Total Petroleum Hydrocarbons + GC-FID	16-oz glass jar	Cool to 4 deg.C	14 days
X	EP Toxicity	glass jar	Cool to 4 deg.C	30 days

- (a) Holding times are from date of collection. All samples will be delivered to the laboratory within 24 hours.
- (b) Includes: arsenic, barium, cadmium, chromium, copper, lead mercury, nickel, and zinc. Precipitate samples will also include: aluminum, calcium, magnesium, iron, manganese, sulfur, carbonates, and chloride.

*Mercury  
5/B 28 days  
∴ No qualifications  
for mercury 7/28/64*

TABLE 3-4

## SUMMARY OF MARINE SEDIMENT SAMPLING PROGRAM

Location	Sample Type	Total No. Samples to be Analyzed
=====		
<b>BLAIR WATERWAY PROPERTY</b>		
<u>Subtidal Sediments</u>		
Two stations	3 cores at each station; 2 depth strata from each core will be composited with the similar depth strata from the other cores at that station.	4
 <b>INNER HYLEBOS WATERWAY PROPERTY</b>		
<u>Subtidal Sediments</u>		
Two stations	3 cores at each station; 3 depth strata from each core will be composited with the similar depth strata from the other cores at that station.	6
Two stations	3 grab samples at each station; 0-2 cm subsample from each grab composited for each station.	2
<u>Intertidal Sediments</u>		
One station	3 cores; 3 depth strata from each core will be composited with the similar depth strata from the other cores.	3
Four stations	3 surface (0-2 cm) samples at each station, compos- ited for each station.	4
 <b>UPPER HYLEBOS WATERWAY PROPERTY</b>		
<u>Subtidal Sediments</u>		
Two stations	3 grab samples at each station; 0-2 cm subsample from each grab composited for each station.	2
Grand Total:		21

TABLE 3-5

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES  
MARINE SEDIMENT SAMPLES (a)

Bottle Code	Analyses	Sample Container	Minimum Sample Size (g wet weight)	Preservation	Maximum Holding Time
PV	Volatile Organics	Glass (no headspace)	40 mL	Cool, 4 deg.C	14 days
PE	Semi-Volatile Organics, Pesticides and PCBs	Glass	50-100	Freeze	1 year
PM	Metals	Glass or Plastic	50	Freeze	6 months
PT	Total Volatile Solids	Glass or Plastic	50	Freeze	6 months
PC	Total Organic Carbon	Glass or Plastic	25	Freeze	6 months
PD	Percent Solids	Glass or Plastic	50	Freeze	6 months
PS	Total Sulfides	Glass or Plastic	50	Cool, 4 deg.C 1 N Zinc Acetate	7 days
PG	Particle Size	Glass or Plastic	100-150	Cool, 4 deg.C	6 months

(a) As specified in PSEP Protocols (Tetra Tech 1986a,b,c)

#### 4.0 CHEMICAL ANALYSIS PROCEDURES

The analytical procedures to be used for analysis of the ground water, soil, onshore sediments, and marine sediment samples are listed in this section. Further details of the procedures are given in the Quality Assurance Project Plan (QAPjP), Appendix B.

##### 4.1 GROUND WATER

Ground water and seep samples will be analyzed for volatile organics, semi-volatile (extractable) organics including p-tert-butylphenol, PCBs, pesticides, formaldehyde and the full suite of priority pollutant dissolved metals in addition to analysis of cations and anions in selected ground water samples. The ground water sample from Well IH-1(s) will be analyzed for volatiles and TPH to detect any contamination originating from the abandoned gas station adjacent to the Inner Hylebos property. Table 4-1 presents the ground water analyses to be conducted for each of the 19 new wells at locations BW-1 through BW-10, the new well at IH-1(s), and the seeps.

Analytical methods to be used and quantification limits are presented in Table 4-2.

##### 4.2 SURFACE SOIL AND ONSHORE SEDIMENTS

Surface soil and onshore sediment samples will be analyzed for classes of chemicals including volatile organics, semi-volatile (extractable) organics, PCBs, pesticides, and a specific suite of total metals. EP Toxicity metals will be analyzed if total metals are detected to be greater than 20 times the Dangerous Waste Criteria for EP Toxicity metals (WAC 173-303-090)<sup>1</sup>. Table 4-3 presents the analyses to be conducted on soil and onshore sediment samples from each of the three properties.

Analytical methods to be used and quantification limits for surface soil and onshore sediments are presented in Table 4-4.

##### 4.3 MARINE SEDIMENTS

All marine sediment samples will be analyzed for the following conventional parameters: total volatile solids, grain size distribution, total organic carbon, percent solids, total sulfides, and ammonia. Analytical protocols will be in accordance with the PSEP recommendations (Tetra Tech, 1986a,b,c), except in the case of ammonia, which shall be

---

<sup>1</sup> The factor of 20 accounts for the 1:20 dilution of sample during analysis. This decision level is conservative in that it assumes that all of the metals in the solid are readily leachable into ground water. The EP Toxicity analysis would then predict what portion of the total metals actually is leachable. The decision levels that would trigger EP Toxicity analyses are: 100 mg/kg As, 2000 mg/kg Ba, 20 mg/kg Cd, 100 mg/kg Cr, 100 mg/kg Pb, 4 mg/kg Hg, 20 mg/kg Se, or 100 mg/kg Ag.



analyzed in accordance with the method of the U.S. Army Corps of Engineers (Plumb, 1981).

All marine sediment samples will also be analyzed for PSDDA and PSEP metals of concern, as well as the organic compounds listed in Table 4-5. Analytical protocols will be in accordance with the PSEP recommendations (Tetra Tech, 1986a,b,c). The limits of detection for each analyte will be at least as low as the PSDDA screening levels (see Table 4-5). Where possible, the PSDDA-recommended limits of detection will be met (see Table 4-6).

Marine sediment contaminant concentrations will be evaluated by comparison with AET values as well as PSDDA screening levels and maximum levels. Sediment concentrations will also be evaluated with respect to the sediment quality objectives and sediment remedial action levels discussed in the Commencement Bay Nearshore/Tideflats Record of Decision (EPA, 1989). This comparison will be used to determine whether the data suggest that sediments in areas identified for natural remediation may meet objectives through natural processes or whether they will require active remediation.

TABLE 4-1  
SUMMARY OF GROUND WATER ANALYSES

Property/Ground Water Source	No. of Samples	Analytical parameters(a)						
		Vola- tiles	Semi-vola- tiles	PCBs/ Pesticides	Formal- dehyde	Dissolved Metals	TPH	Cations/ Anions
BLAIR WATERWAY PROPERTY								
-----								
Monitoring Wells(b)								
BW-1(s)	1	x	x	x	x	x		
BW-1(i)	1	x	x	x	x	x		
BW-1(d)	1	x	x	x	x	x		
BW-2(s)	1	x	x	x	x	x		
BW-3(s)	1	x	x	x	x	x		
BW-3(i)	1	x	x	x	x	x		
BW-3(d)	1	x	x	x	x	x		
BW-4(s)	1	x	x	x	x	x		x
BW-4(i)	1	x	x	x	x	x		x
BW-4(d)	1	x	x	x	x	x		x
BW-5(i)	1	x	x	x	x	x		
BW-6(s)	1	x	x	x	x	x		
BW-7(s)	1	x	x	x	x	x		
BW-7(i)	1	x	x	x	x	x		
BW-8(s)	1	x	x	x	x	x		
BW-9(s)	1	x	x	x	x	x		x
BW-9(i)	1	x	x	x	x	x		x
BW-9(d)	1	x	x	x	x	x		x
BW-10(s)	1	x	x	x	x	x		
INNER HYLEBOS PROPERTY								
-----								
Monitoring Well								
IH-1(s)	1	x						x
Seep		x	x	x		x		
UPPER HYLEBOS PROPERTY								
-----								
Seeps(c)	1	x	x	x		x		

- (a) Metals = Full priority pollutant metals plus Mo, Fe, Mn.  
Semi-volatiles will include p-tert-butylphenol for Blair Waterway wells.  
PCBs = Polychlorinated biphenols.  
TPH = Total Petroleum Hydrocarbons.  
Cations/Anions = Al, Ca, Cl, K, Mg, Na, SO<sub>4</sub>, and Alkalinity.
- (b) s = Screened in shallow aquifer.  
i = Screened in intermediate aquifer.  
d = Screened in deep aquifer.
- (c) Represents a composite seep sample.

TABLE 4-2

METHODS AND QUANTIFICATION LIMITS FOR  
ANALYSIS OF GROUND WATER

Analyte	Analytical Technique	Analytical Method(a)(b)	Quantification Limit
=====			
Organic Constituents			
-----			
Volatile Organics	GC/MS	SW 8240	5-10 ug/L
Semi-volatile (Extractable) Organics	GC/MS	SW 8270	10-50 ug/L
PCBs/Pesticides	GC/ECD	SW 8080	
Formaldehyde	Colorimetric	Lab SOP (c)	50 ug/L
TPH	IR	EP 418.1 and SW 8020	1 mg/L
Inorganic Constituents			
-----			
Dissolved Metals			
(Digestion by Method SW 3005)			
Antimony	Graphite Furnace	SW 7041	60 ug/L
Arsenic	Graphite Furnace	SW 7060	10 ug/L
Cadmium	ICP	SW 6010	5 ug/L(d)
Chromium	ICP	SW 6010	10 ug/L(d)
Copper	ICP	SW 6010	25 ug/L(d)
Iron	ICP	SW 6010	100 ug/L(d)
Lead	ICP	SW 6010	5 ug/L(d)
Manganese	ICP	SW 6010	15 ug/L(d)
Mercury	CV	SW 7470	0.2 ug/L
Molybdenum	Graphite Furnace	SW 7481	15 ug/L
Nickel	Graphite Furnace	SW 7520	15 ug/L
Selenium	Graphite Furnace	SW 7740	5 ug/L
Silver	ICP	SW 6010	10 ug/L(d)
Thallium	ICP	SW 6010	10 ug/L(d)
Zinc	ICP	SW 6010	20 ug/L(d)
Cations/Anions			
-----			
Chloride	IC	EP 300.0	1 mg/L
Sulfate	IC	EP 300.0	1 mg/L
Major Ions (Al,Ca,K,Mg,Na)	ICP or AA	SW 6010 or SW 7000 Series	1-2 mg/L
Alkalinity (Bicarbonate/Carbonate)	Titration	EP 310.1	2 mg/L

(a) SW = Test Methods for Evaluating Solid Waste (SW-846), 3rd Edition, EPA 1986.

(b) EP = Methods for Chemical Analysis of Water and Wastes, EPA 1983.

(c) Procedure based on ASTM proposed method for formaldehyde in water (see Appendix C).

(d) If quantification limit cannot be achieved by SW 6010, corresponding AA method will be used.

NOTE: Quantification limits are affected by sample size, extractability, and matrix interference.

TABLE 4-3

SUMMARY OF SURFACE SOIL  
AND ONSHORE SEDIMENT ANALYSIS

Property/Matrix	No. of Samples	Analytical Parameters(a)							
		Total Metals	EP Tox Metals	Volatiles	Semi- Volatiles	PCBs	Pesti- cides	TPH + GC-FID	Cations/ Anions
BLAIR WATERWAY PROPERTY									
-----									
Surface Soil									
- Outlet Fill Area	2		x						
- Drum Storage Area	2			x	x	x			
- Test Pits	8(est.)	x			x	x			
- Fueling Area	2				x			x	
- Railroad Spur	5	x			x	x	x		
Onshore Sediments				x	x				
- Lincoln Ave. Drainageway	4	x	x(b)	x	x	x	x		
- Boundary Ditches	12	x	x(b)	x	x	x			
- Mud Lake	9				x				
- Outfall and Spillway	2	x	x(b)	x	x	x	x		
Ditch Precipitates	2	x							x
INNER HYLEBOS PROPERTY									
-----									
Surface Soil									
- Underlying the Refuse	6(est.)	x		x	x	x			
- Test Pits	4(est.)	x			x	x			
Onshore Sediment									
- Gas Station Ditch	2			x				x	
- Storm Drains	4	x		x	x	x	x		
Seep Precipitate		x							x
UPPER HYLEBOS PROPERTY									
-----									
Surface Soil									
- Railroad Right-of-Way	5(min.)	x			x	x	x		
- Test Pits	4(est.)	x			x	x			
Onshore Sediment									
- Boundary Ditch	2	x	x(b)	x	x	x	x		
- PVC Standpipe	1	x		x	x	x			

(a) Metals = As, Ba, Cr, Cu, Cd, Pb, Hg, Ni, Zn.

PCBs = Polychlorinated biphenols.

TPH = Total Petroleum Hydrocarbons.

Cations/Anions = Al, Ca, Mg, S, CO<sub>3</sub>, Cl.

(b) EP Toxicity analyses will be conducted only if total metals are sufficiently elevated (see Section 4.2).

TABLE 4-4

METHODS AND QUANTIFICATION LIMITS FOR  
ANALYSIS OF SOILS/ONSHORE SEDIMENTS

Analyte	Analytical Technique	Analytical Method(a)(b)	Quantification Limit
=====			
Organic Constituents(c)			
-----			
Volatile Organics	GC/MS	SW 8240	5-10 ug/kg
Semi-volatile (Extractable) Organics	GC/MS	SW 8270	330-1600 ug/kg
Total Petroleum Hydrocarbons	IR	EP 418.1	1 mg/kg
GC-FID Scan	GC-FID	SW 8015	
PCB	GC-ECD	SW 8080	80-160 ug/kg
Pesticides	GC-ECD	SW 8080	8-160 ug/kg
Inorganic Constituents(c)(d)			
-----			
Total Metals			
(Digestion by Method SW 3050)			
Arsenic	Graphite Furnace	SW 7060	2 mg/kg
Barium	ICP	SW 6010(e)	40 mg/kg
Cadmium	ICP	SW 6010(e)	1 mg/kg
Chromium	ICP	SW 6010(e)	2 mg/kg
Copper	ICP	SW 6010(e)	5 mg/kg
Lead	ICP	SW 6010(e)	1 mg/kg
Mercury	CV	SW 7471	.2 mg/kg
Nickel	ICP	SW 6010(e)	8 mg/kg
Zinc	ICP	SW 6010(e)	4 mg/kg
Cation/Anions			
Carbonates		Lab SOP	(f)
Chloride		Lab SOP	(f)
Sulfur		Lab SOP	(f)
Major Ions (Al, Ca, Mg)	ICP	SW 6010	(f)

(a) SW = Test Methods for Evaluating Solid Waste (SW-846), 3rd Edition, EPA 1986.

(b) EP = Methods for Chemical Analysis of Water and Wastes, EPA 1983.

(c) All organics and inorganics will be reported on a dry weight basis (DB).

(d) EP Toxicity analyses, if required for metals, will be conducted in accordance with the EP Publication SW-846.

(e) If quantification limit cannot be achieved by SW 6010, corresponding AA method will be used.

(f) Analyses of cations/anions on precipitate samples are for identification purposes only.

NOTE: Quantification limits are affected by sample size, extractability and matrix interference.

TABLE 4-5

CURRENT PSDDA  
SCREENING LEVEL (SL) AND MAXIMUM LEVEL (ML)  
GUIDELINE CHEMISTRY VALUES (a)  
(Dry-Weight Normalized)

Chemical	Screening Level (SL)	Maximum Level (ML)
Metals (mg/kg dry weight, ppm)		
Antimony (b)	20	200
Arsenic (c)	57	700
Cadmium (c)	0.96	9.6
Copper (b)	81	810
Lead (c)	66	660
Mercury	0.21	2.1
Nickel (b) (d) (e)	140	
Silver (b)	1.20	6.1
Tributyl Tin (f)	30	
Zinc (b)	160	1,600
Organics (ug/kg dry weight, ppb)		
LPAH	610	6,100
Naphthalene	210	2,100
Acenaphthylene	64	640
Acenaphthene	63	630
Fluorene	64	640
Phenanthrene	320	3,200
Anthracene	130	1,300
2-Methylnaphthalene	67	670
HPAH	1,800	51,000
Fluoranthene	630	6,300
Pyrene	430	7,300
Benzo(a)anthracene	450	4,500
Chrysene	670	6,700
Benzofluoranthenes	800	8,000
Benzo(a)pyrene	680	6,800
Indeno(1,2,3-c,d)pyrene	69	5,200
Dibenzo(a,h)anthracene	120	1,200
Benzo(g,h,i)perylene	540	5,400

- (a) The PSDDA screening levels and maximum levels were established based on the 1986 AET values. The PSDDA maximum levels were set at the highest 1986 AET value. The PSDDA screening levels were set at 1/10 of the maximum level or at the reference area concentration, whichever is higher, but not greater than the lowest AET.
- (b) Value set by the total acid digest extraction method.
- (c) Value set by the strong acid digest extraction method.
- (d) Nickel is no longer on the PSDDA list of chemicals of concern.
- (e) No ML is established for these chemicals.
- (f) Tributyl tin is on the list of chemicals of concern for limited areas only.

TABLE 4-5 (continued)

CURRENT PSDDA  
SCREENING LEVEL (SL) AND MAXIMUM LEVEL (ML)  
GUIDELINE CHEMISTRY VALUES (a)  
(Dry-Weight Normalized)

Chemical	Screening Level (SL)	Maximum Level (ML)
=====		
Chlorinated Hydrocarbons		
1,3-Dichlorobenzene (e)	170	
1,4-Dichlorobenzene	26	260
1,2-Dichlorobenzene	19	350
1,2,4-Trichlorobenzene	6.4	64
Hexachlorobenzene (HCB)	23	230
Phthalates (e)		
Dimethyl phthalate	160	
Diethyl phthalate	97	
Di-n-butyl phthalate	1,400	
Butyl benzyl phthalate	470	
Bis(2-ethylhexyl)phthalate	3,100	
Di-n-octyl phthalate	6,200	
Phenols		
Phenol	120	1,200
2 Methylphenol	10	72
4 Methylphenol	120	1,200
2,4-Dimethyl phenol	10	50
Pentachlorophenol	69	690
Miscellaneous Extractables		
Benzyl alcohol	10	73
Benzoic acid	216	690
Dibenzofuran	54	540
Hexachloroethane	1,400	14,000
Hexachlorobutadiene	29	290
N-Nitrosodiphenylamine	22	220
Volatile Organics		
Trichloroethene	160	1,600
Tetrachloroethene	14	210
Ethylbenzene	10	50
Total Xylene	12	160
Pesticides		
Total DDT	6.9	69
Aldrin (e)	10	
Chlordane (e)	10	
Dieldrin (e)	10	
Heptachlor (e)	10	
Lindane (e)	10	
Total PCB's	130	2,500

TABLE 4-6

PSDDA-RECOMMENDED LIMITS OF DETECTION  
IN SEDIMENT MARINE MATRICES <sup>1</sup>

Metals and Metalloids	mg/kg Dry Weight
=====	=====
Antimony	0.1
Arsenic	0.1
Cadmium	0.1
Copper	0.1
Lead	0.1
Mercury	0.01
Nickel	0.1
Silver	0.1
Zinc	0.2
Manganese	2.0
Organic Compounds	µg/kg Dry Weight
=====	=====
Volatiles	10-20
Semi-volatiles	1-50
Pesticides/PCBs	0.1-15

<sup>1</sup> For this project, detection limits will be at least as low as the PSDDA screening levels (Table 4-5). Above values are detection limit goals, only.



## 5.0 PRESENTATION OF RESULTS

A separate written report will be prepared for each property when the data evaluation is complete. Each report will summarize information regarding the site investigations, sampling, laboratory test results, our interpretations of those findings in relation to existing data, and a brief description of possible cleanup objectives.

## 6.0 REFERENCES

Plumb, 1981. US Army Corps of Engineers.

Tetra Tech, Inc., 1986a. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound, Puget Sound Estuary Program. March 1986.

\_\_\_\_\_, 1986b. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment, and Tissue Samples, Puget Sound Estuary Program. August 1986.

\_\_\_\_\_, 1986c. Recommended Protocols for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples, Puget Sound Estuary Program. December 1986.

Washington, State of, Department of Ecology, 1988. Minimum Standards for Construction and Maintenance of Wells, WAC 173-160. May 5, 1988.

U.S. Environmental Protection Agency, 1989. Commencement Bay Nearshore/Tideflats Record of Decision. September 1989.

## APPENDICES

APPENDIX A

# **Port of Tacoma Phase II Environmental Investigation Health and Safety Plan**

## EMERGENCY CONTACT NUMBERS

Hospital: St. Joseph's Hospital (Route Map Follows)

Address: 1718 S. "I" Street, Tacoma, Washington

Phone: 591-6660 (Contact Emergency Department)

Tacoma Fire Department: 911

Tacoma Police Department: 911

Pierce County Health Department: 591-6450

Poison Control Center: 1-800-732-6985

State Environmental Agency - 24 Hour: 1-753-2353

EPA-Regional Office - Seattle 1-442-1263

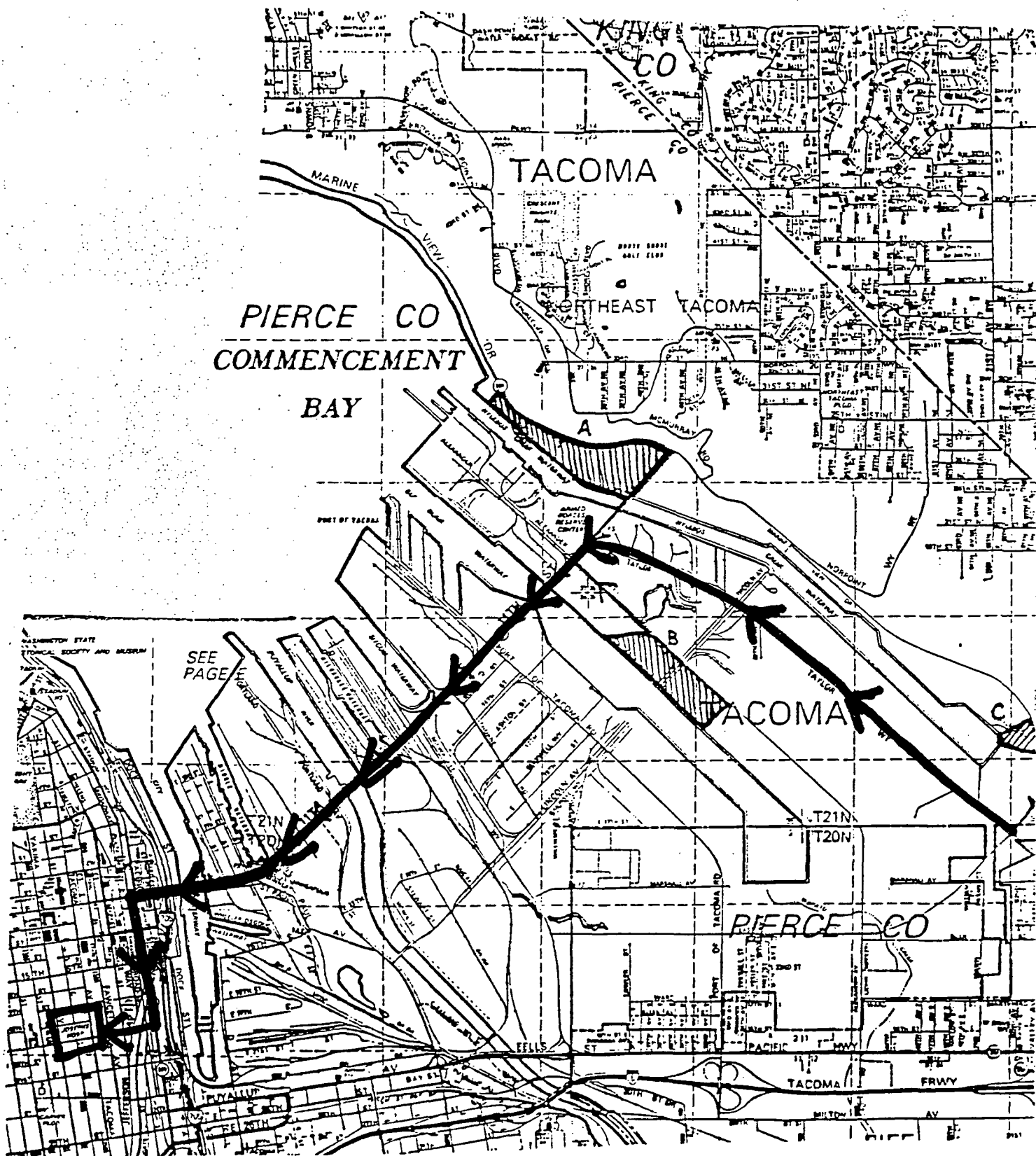
Marine Safety Office: 1-286-5550  
(Coast Guard Dispatch)

State Police: 593-2424

Onsite Coordinator: Ken Chaput

Site Telephone: None

Nearest Telephone Location: Reichhold Chemical (Blair Site)



ROUTE TO HOSPITAL

LANDAU ASSOCIATES, INC.

PORT OF TACOMA  
PHASE II PROPERTY INVESTIGATION

WORK LOCATION PERSONNEL PROTECTION  
AND SAFETY EVALUATION FORM

Attach Pertinent Documents/Data  
Fill in Blanks As Appropriate

Job # 118-02.23

Prepared by Julie L. Wilson

Date November 27, 1989

A. Work Location Description

Tacoma, Washington  
Commencement Bay Area  
Site A-Marine View Dr.

1. Name Port of Tacoma - 3  
sites. See attached  
Figure 1.
2. Location Site B-Alexander Avenue  
Site C-Marine View Drive
3. Anticipated activities: Installation of monitoring wells,  
ground water, soil and sediment sampling - refer to Work Plan.
4. Size A=72.9 acres, B=43.4 acres, C=5.6 acres
5. Surrounding Population Industrial area-designated Superfund area  
(Commencement Bay)
6. Buildings/Homes/Industry Chemical manufacturing, refineries,  
other industrial operations
7. Topography Flat and at or slightly above sea level.
8. Anticipated Weather Cool (35 to 55°F), cloudy, possible rain.
9. Unusual Features Mud flats associated with Site A (Inner  
Hylebos) and ditches subject to water levels corresponding to  
tidal fluctuations.
10. Site History Inner Hylebos (A) sawmill and docking operation,  
Blair Waterway (B) wood chip operation, Upper Hylebos (C) possible  
equipment/wood chip storage.

**B. Hazard Description**

1. Background Review: Complete (X) Partial ( )

If partial, why? \_\_\_\_\_

2. Hazard Level: B ( ) C (X) D (X) Unknown ( )  
Justification Concentration of chemicals in soil do not represent  
inhalation hazard - will upgrade to Level C if  
monitoring indicates necessity.

3. Types of Hazards: (Attach additional sheets as necessary)

- A. Chemical (X) Inhalation ( ) Explosive ( )  
Particulate  
Biological ( ) Ingestion (X) O<sub>2</sub> Def. ( )  
Skin Contact (X)

Describe Volatile, semi-volatile chemical contamination  
and metals in soil, ground water, surface water and sediments  
from multiple sources.

- B. Physical (X) Cold Stress ( ) Noise ( )  
Heat Stress ( ) Other ( )

Describe See page 5

- C. Radiation ( )

Describe N/A

4. Nature of Hazards:

Air (X) Describe Possible volatilization of contaminants  
from soil, water, sediments

Soil (X) Describe Known contamination with volatiles,  
semi-volatiles and metals



**Surface Water** ( X ) **Describe** Possible contamination with  
volatiles, semi-volatiles, metals

**Ground Water** ( X ) **Describe** Possible contamination with  
volatiles, semi-volatiles, metals

**Other** ( ) **Describe** \_\_\_\_\_  
\_\_\_\_\_

### 5. Chemical Contaminants of Concern ( ) N/A

Contaminant	TLV (ppm)	I.D.L.H. (ppm)	Source/Quantity Characteristics	Route of Exposure	Symptoms of Acute Exposure	Instruments Used to Monitor Contaminant
1) 1,2-Dichloro- ethene	200	4,000	17ppb-ground water	Inhalation/ Dermal	Irrit. eyes, respiratory system	PID
2) Ethyl Benzene	100	2,000	14ppb-ground water	Inhalation/ Dermal	Irrit. eyes, skin, respiratory system	PID
3) Formaldehyde	1.0	--	378ppb-ground water	Inhalation/ Dermal	Irrit. eyes, resp. system, nausea	PID
4) Pentachloro- phenol	0.5 mg/m <sup>3</sup> (skin)	150mg/u <sup>3</sup>	13000ppb-ground water	Inhalation Dermal	Irrit. eyes, nose, throat dizziness, nausea	PID
5) Vinyl Chloride	5	--	18ppb-ground water	Inhalation	Lassitude, abdom, pain	PID
6) Arsenic	10ug/m <sup>3</sup> (NIOSH)	--	86ppm (old ditch fill)	Inhalation/ Ingestion	Resp. irritation, flu-like symptoms	--
7) Lead	0.15 mg/m <sup>3</sup>	--	60ppm (old ditch fill)	Inhalation/ Ingestion	Lassitude, abdom. pain	--

A  
Other volatile, semi-volatile and metal contaminants have been found onsite. This represents the "highest risk" contaminants, based on toxicity and/or concentration. Adequate protection from exposure to these constituents will ensure protection from all detected to date.

## HEALTH AND SAFETY RULES

All personnel working in the field will follow these rules and procedures:

1. All personnel will conduct themselves in a professional manner at all times.
2. No personnel will be admitted to the site work zone without proper safety equipment and requisite training.
3. All personnel must comply with the established health and safety procedures. Any LAI or subcontractor employee who does not comply with this Health and Safety Plan may be immediately dismissed from the site.
4. Working while under the influence of toxicants, narcotics, or controlled substances is prohibited. Prescription drugs should not be taken by personnel if the potential for contact with toxic substances exists, unless approved in writing by a qualified, informed physician.
5. Firearms, ammunition, and fireworks or explosives are prohibited.
6. Climbing or standing on machinery (other than drill rigs or service trucks) or equipment is to be avoided when possible.
7. Long hair must be contained inside a hard hat.
8. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in the work zone.
9. Smoking is only allowed in designated areas.
10. Disposable clothing and gloves will be used whenever possible to minimize the risk of cross-contamination.
11. The number of personnel and the amount of equipment in contaminated areas will be minimized to allow for efficient site operations.
12. Soil samples will be collected only by trained and authorized personnel.
13. Contact with contaminated or potentially contaminated material should be avoided. Efforts will be made to stage employee activity upwind of material processing activities, to the extent reasonably possible.
14. Whenever possible, walking through puddles and mud, or across any discolored ground surface is to be avoided. Kneeling, leaning, sitting, or placing equipment on drums, containers, vehicles, or the ground is to be avoided when possible.
15. Proper decontamination procedures must be followed before leaving the site, unless medical emergencies dictate otherwise (See Section I).
16. Meals at the site will only be eaten in the support zone.
17. Caution will be observed when proceeding on foot through open areas.

18. Unapproved work clothes or equipment will not be allowed within the exclusion zone.
19. Exchange of personal protective equipment will not be allowed.

6. Physical Hazards of Concern ( ) N/A

Hazard	Description	Location	Procedures Used to Monitor Hazard
1) Ditch Sampling	Sloped ditch sides	Site A, B, C	Seek least hazardous area to access, have lines available as required.
2) Soft Footing	Shoreline and tidal mud flat areas	Site A, B, C	Ensure adequate footing before proceeding. Use of plank paths to traverse mud flat areas. Possibly limit sampling to area edge.
3) Barrel Handling	Subcontractor moving steel barrels of soil and water from drill sites to temporary staging area	Site A, B, C	Use appropriate precautions when moving full barrells.
4) Marine Sediment Sampling	Boat activities: boat-deployed sampling gear	Site A, B, C	Contractor responsible for marine sediment sampling will provide Health and Safety guidance appropriate for collecting samples of potentially contaminated marine sediments.

7. Work Location Instrument Readings ( ) N/A See attachment -  
Site Monitoring

Location Site A - Inner Hylebos

Percent O<sub>2</sub> \_\_\_\_\_

Radioactivity \_\_\_\_\_

FID \_\_\_\_\_

Other \_\_\_\_\_

Percent IEL \_\_\_\_\_  
Above background for 5 min.

PID or 5ppm 30 seconds \_\_\_\_\_

Other \_\_\_\_\_

Other \_\_\_\_\_

Location Site B - Blair Waterway

Percent O<sub>2</sub> \_\_\_\_\_

Radioactivity \_\_\_\_\_

FID \_\_\_\_\_

Other \_\_\_\_\_

Percent IEL \_\_\_\_\_  
Above background for 5 min.

PID or 5ppm 30 seconds \_\_\_\_\_

Other \_\_\_\_\_

Other \_\_\_\_\_

Location Site C - Upper Hylebos

Percent O<sub>2</sub> \_\_\_\_\_

Radioactivity \_\_\_\_\_

FID \_\_\_\_\_

Other \_\_\_\_\_

Percent IEL \_\_\_\_\_  
Above background for 5 min.

PID or 5ppm 30 seconds \_\_\_\_\_

Other \_\_\_\_\_

Other \_\_\_\_\_

Location \_\_\_\_\_

Percent O<sub>2</sub> \_\_\_\_\_

Radioactivity \_\_\_\_\_

FID \_\_\_\_\_

Other \_\_\_\_\_

Percent IEL \_\_\_\_\_

PID \_\_\_\_\_

Other \_\_\_\_\_

Other \_\_\_\_\_

8. Hazards expected in preparation for work assignment. ( ) N/A

Describe: Low level soil contamination with VOAs, semi-VOAs, metals

Ground water contamination with same. Physical hazards associated with  
footing (ditch sampling) and site access (mud flats).

## SITE MONITORING

The health and safety site coordinator will have a Photovac TIP on site at all times and will establish background readings well upwind of any excavation, spoils pile, bore-hole, etc.

Given the fact that volatile and semi-volatile organic contaminants may be present onsite in soil and ground water, any consistent readings in the breathing zone that are perceptibly above the upwind background for more than five minutes, or any readings in the breathing zone greater than 5 ppm greater than 30 seconds in duration shall be the action level for air purifying respirators equipped with organic vapor acid gas cartridges. Work may resume when appropriate respiratory protection is being used or when monitoring indicates that levels have fallen below action levels.

When Level C conditions apply, given the rapid breakthrough time of such substances as vinyl chloride, cartridges will be replaced after each day of use or immediately upon any indication of "breakthrough," whichever is less.

If half-face respirators are used, any readings consistently greater than 5 ppm above background for five minutes, greater than 10 ppm other than for a brief peak, or any peak reading greater than 25 ppm in the breathing zone will be the action level for discontinuing work.

C. Personal Protective Equipment

1. Level of Protection

A ( ) B ( ) C (X) D (X) Location/Activity:

All sites - D with upgrade to C if PID reading > background for 5 min.  
or peak > 5 ppm (30 seconds).

A ( ) B ( ) C ( ) D ( ) Location/Activity:

2. Protective Equipment (specify probably quantity required)

Respiratory ( ) N/A

( ) SCBA, Airline

(X) Full Face Respirator  
(Cart. \_\_\_\_\_)

(X) Half Face Respirator  
(Cart. HEPA/organic vapor)

( ) Escape Mask

( ) None

( ) Other

( ) Other \_\_\_\_\_

Head & Eye ( ) N/A

(X) Hard Hat

(X) Goggles

( ) Face Shield

( ) Chemical Eyeglasses

( ) None

( ) Other \_\_\_\_\_

Clothing ( ) N/A

( ) Fully Encapsulating Suit

( ) Chemically Resistant  
Splash Suit

( ) Apron, Specify \_\_\_\_\_

(X) Tyvek Coverall

( ) Saranex Coverall

( ) Coverall, Specify \_\_\_\_\_

(X) Other Full body rain gear.  
(alternate to Tyvek)

( ) Other \_\_\_\_\_

Hand Protection ( ) N/A

(X) Undergloves Vinyl  
Type

( ) Gloves \_\_\_\_\_  
Type

(X) Overgloves Nitrile  
Type

( ) None

(X) Other taping of wrists

(as required by site  
safety officer)



Foot Protection ( ) N/A

( ) Safety Boots

( ) Disposable Overboots

(X) Other steel toe/shank neoprene

3. Monitoring Equipment ( ) N/A See attachment - Site Monitoring

( ) CGI

(X) PID

( ) O<sub>2</sub> Meter

( ) FID

( ) Rad Survey

( ) Other \_\_\_\_\_

( ) Detector Tubes \_\_\_\_\_

Type: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

D. Personnel Decontamination (Attach Diagram)

Required (X) Soap/water hands  
and face

Not Required ( )

Equipment Decontamination (Attach Diagram)

Required (X)

Not Required ( )

If required, describe and list equipment High pressure water

wash of heavy equipment. Sampling equipment decon withalconox/water

wash, tap water rinse, DI water rinse.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

E. Personnel

	Name	Work Location Title/Task	Medical Current	Fit Test Current	Certificate Level
1.	Rebekah Brooks	Field Geologist	( X )	( X )	( F )
2.	Tom Colligan	Field Geologist	( X )	( X )	( F )
3.	Sanh Kea	Field Technician	( X )	( X )	( F )
4.	Brian Butler	Project Geologist	( X )	( X )	( F )
5.			( )	( )	( )
6.			( )	( )	( )
7.			( )	( )	( )
8.			( )	( )	( )
9.			( )	( )	( )
10.			( )	( )	( )

Site Safety Coordinator Ken Chaput

P. Activities Covered Under this Plan

Task No.	Description	Preliminary Schedule
----------	-------------	-------------------------

Refer to Work Plan

H. Contingency Contacts

<u>Agency</u>	<u>Contact</u>	<u>Phone Number</u>
Fire Department	(Tacoma)	911
Police Department	(Tacoma)	911
Health Department	(Pierce County)	591-6450
Poison Control Center		1-800-732-6985
State Environmental Agency	(WDOE-24 hour)	753-2353
EPA-Regional Office	(Seattle-Region 10)	442-1263
Coast Guard	Tacoma	
Spill Contractor		
State Police		593-2424
Onsite Coordinator	Ken Chaput	
Site Telephone	none	
Nearest Telephone	Reichold Chemical (Blair Site) (Location)	

I. Contingency Plans

Spill, Accidental Release; Describe N/A

Fire, Explosion; Describe N/A

Other; Describe N/A

Exit Routes, Communication Systems; Describe N/A

**MEDICAL EMERGENCY**

**Name of Hospital** St. Joseph's Hospital

**Address:** 1718 South I Street, Tacoma

**Phone No.** 591-6660

**Name of Contact:** Emergency Department

**Address:** \_\_\_\_\_

**Phone No.** \_\_\_\_\_

**Route to Hospital (attach map):** Route varies by site - see Figure 1 (attached)

**Travel Time from**  
**Site (minutes)** less than 15 minutes

**Distance to**  
**Hospital (miles)** 4-5 miles

**Name/Number of 24 Hour Ambulance Service:** 911

G. Subcontractor's Health and Safety Program Evaluation ( ) N/A

Name and Address of Subcontractor: Tacoma Pump and Drilling (tel: 847-6087)

30316 Mountain Highway E.

Activities to be Conducted by Subcontractor: Drilling, well installation

Item	EVALUATION CRITERIA		Comments
	Adequate	Inadequate	
Medical Surveillance Program	( )	( )	
Personal Protective Equipment Availability	( )	( )	
Onsite Monitoring Equipment Avail.	( )	( )	
Safe Working Procedures Specification	( )	( )	
Training Protocols	( )	( )	
Ancillary Support Procedures (if any)	( )	( )	
Emergency Procedures	( )	( )	
Evacuation Procedures Contingency Plan	( )	( )	
Decontamination Procedures Equipment	( )	( )	
Decontamination Procedures Personnel	( )	( )	

GENERAL HEALTH AND SAFETY PROGRAM EVALUATION: ADEQUATE ( ) INADEQUATE ( )

Additional Comments: \_\_\_\_\_

Evaluation Conducted By: \_\_\_\_\_ Date: \_\_\_\_\_







APPENDIX B

**Port of Tacoma  
Phase II Environmental Investigation  
Quality Assurance Project Plan**

## APPENDIX B

### QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPjP) establishes the quality assurance (QA) objectives for the Phase II Environmental Investigation in support of the Port of Tacoma property transfers and the QA organization and procedures developed to meet project objectives.

The data quality objectives (DQOs) established for this project reflect the intended use of project data and, as such, prescribe the level of quality, accuracy, precision, completeness, comparability, and representativeness of data to be collected and analyzed.

The QA procedures presented in this section are developed to assure that DQOs described in Section 8.1 are met as well as to assure that data generated are representative of actual conditions at the site. The overall goal of the project QA program is to assure a reasonable degree of confidence in project data and results through the establishment of a rigorous system of quality and performance checks on data collection, analysis, and reporting activities as well as appropriate and timely corrective action to achieve compliance with established performance and quality criteria.

This section presents the procedures and methods for sample handling and chain-of-custody, instrument/equipment calibration, chemical analysis, data validation and reporting, internal quality control, auditing, preventive maintenance, data assessment, corrective actions, and QA reports developed to meet project and QA objectives.

#### 1.0 PROJECT DATA QUALITY OBJECTIVES

EPA has identified five general levels of analytical data quality as being potentially applicable to site investigations conducted under CERCLA. These levels are summarized below:

- o Level V - Non-standard methods. Analyses which may require method modification and/or development. CLP Special Analytical Service (SAS) are considered Level V.
- o Level IV - CLP Routine Analytical Services (RAS). This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data. Some regions have obtained similar support via their own regional laboratories, university laboratories, or other commercial laboratories.
- o Level III - Laboratory analysis using methods other than the CLP RAS. This level is used primarily in support of engineering studies using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS, without the CLP requirements for documentation.

- o Level II - Field analysis. This level is characterized by the use of portable analytical instruments which can be used onsite, or in mobile laboratories stationed near a site (closed-support labs). Depending upon the types of contaminants, sample matrix, and personnel skills, qualitative and quantitative data can be obtained.
- o Level I - Field screening. This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.

The appropriate level of analytical data quality is determined by the DQOs of each portion of the project. Laboratory and field data generated during this project will provide the basis for accomplishing the test objectives listed in the Work Plan. Data quality objectives for the test objectives are discussed below.

The DQOs for Project Objectives 1 and 3 (described in Section 1.0 of the Work Plan) are to obtain data of sufficient quality to determine the constituents of concern and their concentrations in areas of the properties most likely to have contamination present from either onsite or offsite sources. Inaccurate or incomplete data could result in incorrect conclusions concerning the contamination status of the properties.

The DQO for Project Objective 2 is to determine the concentration of contaminants in marine sediments to support decisions concerning remediation. As open-water disposal is not being considered, PSDDA criteria do not directly apply.

The DQO for Project Objective 4 is to determine the concentrations of previously detected contaminants in Mud Lake sediments. Accuracy and precision must be sufficient to draw conclusions concerning the contaminant concentrations.

It is expected that Level III data quality will be sufficient to achieve the DQOs for all Project Objectives. In order to maximize comparability with other data in the area or with future data from these properties, a high level of quality control will be maintained. Quality control procedures equivalent to Level IV will be followed where applicable without the extensive documentation. PSEP protocols will be followed and PSDDA screening levels will be used as maximum detection limit for marine sediment samples in order to maximize the comparability and usefulness of the data generated in this property transfer.

Laboratory quality control measures described in the methods will be performed. Data validation will be performed by evaluating detection limits, laboratory blanks, matrix spikes, matrix spike duplicates, surrogate recoveries, and holding times. Further validation, corrective action, and reporting procedures are described in Sections 7.0 and 12.0.

## **2.0 PROJECT QA ORGANIZATION AND RESPONSIBILITIES**

The project QA organization, including individuals with QA responsibility and lines of QA authority, is shown on Figure B-1. Specific project Quality Assurance responsibilities are listed in Table B-1.

The Landau Quality Assurance Officer (QAO) will be responsible for the daily oversight of quality control during the environmental investigation and will maintain communication with the laboratory QAO.

## **3.0 DATA QUALITY OBJECTIVES FOR PARCC PARAMETERS**

The purpose of this section is to describe DQOs for precision, accuracy, representativeness, completeness, and comparability (PARCC) of project data.

### **3.1 PRECISION AND ACCURACY**

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. It is expressed as a standard deviation or relative percent difference. Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property),  $X$ , with an accepted reference or true value,  $T$ . Accuracy can be expressed as the difference between the two values ( $X-T$ ), the difference as a percentage of the reference or true value ( $100 (X-T)/T$ ), or as a ratio ( $X/T$ ). Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of spiked samples.

Accuracy and precision are determined through quality control parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, performance evaluation samples, and blind field duplicates. The project data quality objectives for the evaluation of these parameters are based on those given in the EPA method, the CLP SOW (EPA, 1987, 1988a), or on functional guidelines outlined by the EPA for evaluating organic and inorganic analyses (EPA, 1988b,c). QC objectives (control limits expressed as percent) for surrogate recoveries, and percent recovery and relative percent difference (RPD) for matrix spikes and matrix spike duplicates for this project are listed in Tables B-2 and B-3. Control limits listed in these tables are consistent with EPA guidelines contained in the CLP SOWs (EPA, 1987, 1988a). These control limits are considered to be QC goals for data acceptance. If the required quality control limit for replication or recovery is not met, corrective action will be performed by the laboratory following the guidelines presented in Section 12.0. If the corrective action is performed and QC objectives still are not met, the Landau QAO will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken,

if appropriate. Such action may include re-analysis of the sample or other determination to be made by the Landau QAO.

In addition to spikes and matrix spike duplicates, QC samples for verification of precision and accuracy include blind field duplicates.

If results for the blind field duplicates are outside the control limits, corrective action and/or data qualification requirements will be determined on a case-by-case basis by the Landau QAO. Blind field duplication can be poor due to sample inhomogeneity. Therefore, corrective action will be determined by the Landau QAO and discussed in the data QA report.

### **3.2 REPRESENTATIVENESS**

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Sample locations and field sampling procedures have been chosen to maximize representativeness.

### **3.3 COMPLETENESS**

Completeness is a measure of the proportion of data specified in the sampling plan which is determined to be valid. The QA objective for completeness during this project will be 90 percent.

### **3.4 COMPARABILITY**

Comparability is an expression of the confidence with which one data set can be compared to another. All measurements will be made so that results are consistent and representative of the media and conditions measured. All data will be calculated, qualified, and reported in units consistent with EPA guidelines. Method detection limits and units to be reported are described in Tables 4-2, 4-4, and 4-6 of the Work Plan.

## **4.0 SAMPLE HANDLING PROCEDURES**

### **4.1 SAMPLE COLLECTION AND ANALYSIS**

Sampling sites have been selected based on the results of the Phase I Environmental Investigations. Phase II samples will be collected and analyzed to supplement existing data and to provide information on areas of the properties which have not been previously sampled. Further details of sample collection and analysis are described in Section 3.0 of the Work Plan. All soil borings will be logged by a field geologist on the Log of Exploration form included as Figure B-2.

## 4.2 SAMPLE CUSTODY

This section describes standard operating procedures for sample identification and chain-of-custody that will be used for the project. The purpose of these procedures is to ensure that the quality and integrity of the samples is maintained during their collection, transportation, storage and analysis.

Sample identification documents will be carefully prepared so that sample identification and chain-of-custody can be maintained and sample disposition controlled. Sample identification documents will include:

- o Field notebooks,
- o Sample collection forms,
- o Sample labels, and
- o Chain-of-custody records.

Copies of the Sample Collection Form, the Sample Container Label, the Chain-of-Custody Record, and the Chain-of-Custody Seal are included as Figures B-3, B-4, B-5, and B-6.

### Chain of Custody

The primary objective of chain-of-custody procedures is to provide an accurate written or computerized record that can be used to trace the possession and handling of a sample from collection to completion of all required analyses. A sample is in custody if it is:

- o In someone's physical possession,
- o In someone's view,
- o Locked up, or
- o Kept in a secured area that is restricted to authorized personnel.

### Field Custody Procedures

The following Field Custody Procedures will be followed:

- o As few persons as possible will handle samples.
- o Sample bottles will be obtained precleaned from the laboratory performing the analyses, or from an approved retail source. Coolers or boxes containing cleaned bottles will be sealed with a custody tape seal during transport to the field or while in storage prior to use.
- o The sample collector will be personally responsible for the care and custody of samples collected until they are transferred to another person, or dispatched properly under chain-of-custody rules.
- o The sample collector will record sample data in the field notebook.
- o The site team leader will determine whether proper custody procedures were followed during the fieldwork and decide if additional samples are required.

## Laboratory Custody Procedures

A designated sample custodian will accept custody of the shipped samples and certify that the sample identification number matches that on the chain-of-custody record. Pertinent information as to shipment, pickup, and courier will be entered in the "Remarks" section. The custodian will then enter sample identification number data into a bound logbook, which is arranged by a project code and station number.

### 4.3 TRANSFER OF CUSTODY AND SHIPMENT

When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Record and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Project documentation of sample custody will be verified by the Landau QAO during regular review of the data validation package.

The following procedures will be followed:

- o The coolers in which samples are packed must be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them must sign, date, and note the time on the chain-of-custody record to document sample custody transfer.
- o Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the chain-of-custody record and traffic report.
- o All shipments will be accompanied by the chain-of-custody record identifying their contents. The original record will accompany the shipment. The other copies will be distributed as appropriate to the team leader and project manager.
- o If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, a bill of lading will be used. Freight bills, Postal Services receipts, and bills of lading will be retained as part of the permanent documentation.

### 4.4 SAMPLE IDENTIFICATION

Labels will be covered with Mylar tape. All containers with samples will be identified using the following format on labels or tags fixed to the sample container:

PT-X-XX-##

- o PT - This set of initials indicates the specific sampling project (Port of Tacoma).
- o X- This initial identifies the property from which sample was collected: Blair Waterway (B), Inner Hylebos (I), or Upper Hylebos (U).



- o XX-##- These initials identify the sample location. Actual sample locations will be recorded in the task log. Field QC samples will be coded as individual samples and identified in the daily field log and on the Sample Collection Form.

For example, a ground water sample from Well BW1S on the Blair Waterway property would be labelled: PTB-BW1S-1. Each sample will be labeled, chemically preserved if required, and sealed immediately after collection. To minimize handling of sample containers, labels will be filled out using waterproof ink and will be firmly affixed to the sample containers and protected with Mylar tape.

The sample label will give the following information:

- o Name of sampler,
- o Date, time, and location of collection,
- o Sample number,
- o Analysis required, and
- o Preservation.

#### 4.5 FIELD DOCUMENTATION

##### Daily Field Logs

Daily field logs and data forms are necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. All daily logs will be kept in a bound waterproof notebook containing numbered pages. All entries will be made in waterproof ink, dated, and signed. No pages will be removed for any reason. Corrections will be made according to the procedures given at the end of this section.

All field logs and forms will be retained by the Landau Field Coordinator and secured in a safe place.

##### Corrections to Documentation

As with any data logbooks, no pages will be removed for any reason. If corrections are necessary, these will be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside. The correction will be initialed and dated. Most corrected errors will require a footnote explaining the correction.



If an error is made on a document assigned to one individual, that individual may make corrections simply by crossing a line through the error and entering the corrected information. The incorrect information should not be obliterated. Any subsequent error discovered on a document should be corrected by the person who made the entry. All corrections will be initialed and dated.

### Photographs

Photographs will be taken of the sampling activities. All photographs will be documented, with the following information noted in the task log:

- o Date, time, and location photograph was taken;
- o Photographer (signature);
- o Weather conditions;
- o Description of photograph taken;
- o Reasons why photograph was taken;
- o Sequential number of the photograph and the film roll number; and
- o Camera lens system used.

After the photographs have been developed, the information recorded in the field notebook will be transferred to the back of the photographs.

## 4.6 SAMPLE PACKAGING AND SHIPPING

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the United States Department of Transportation (DOT) in the Code of Federal Regulations, 49 CFR 171 through 177.

### Sample Packaging

Samples will be packaged carefully to avoid breakage or contamination and will be shipped to the laboratory at proper temperatures. The following sample package requirements will be followed:

Each sample will be placed in a separate plastic bag. A picnic cooler will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut from the inside and outside, and a large plastic bag will be used as a liner for the cooler. Approximately 1 inch of packing material, such as asbestos-free vermiculite, will be placed in the bottom of the liner. The sample bottles will be placed

in the lined cooler. All coolers will contain ice or frozen gel packs. The lined cooler will be filled with packing material, and the large liner bag will be taped shut. Sufficient packing material will be used to prevent sample containers from making contact during shipment. The paperwork going to the laboratory will be placed inside a plastic bag and taped inside the cooler lid.

The cooler will be taped shut with strapping tape. Chain-of-Custody seals will be placed on the cooler (see Figure B-6). The cooler will either be shipped on an overnight carrier or transported by automobile.

## 5.0 CALIBRATION PROCEDURES

All instruments and equipment used during sampling and analysis will be operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodology reference. Calibration procedures will be in general accordance with the laboratory QA plans. Operation, calibration, and maintenance will be performed by personnel properly trained in these procedures. Documentation of all routine and special maintenance and calibration information will be maintained in an appropriate logbook or reference file, and will be available upon request. Calibration procedures and schedules are described in the laboratory QA plan.

## 6.0 ANALYTICAL PROCEDURES

The analytical procedures to be used in the Environmental Investigation are listed in Table B-4 along with the sample matrices associated with each analysis.

Volatile and semi-volatile organics will be analyzed in ground water, soil, and sediment samples using the GC/MS methods, SW 8240 and 8270. Pesticides and PCBs will be analyzed on the same matrices using the GC/ECD method SW 8080. Formaldehyde, a constituent of concern in the Reichhold ground water adjacent to the Blair Waterway property, will be analyzed in ground water samples using a proposed ASTM method, presented in Appendix C. Based on results of Reichhold ground water monitoring, an additional analyte will be added to the semi-volatile analysis, p-tert-butylphenol.

Full priority pollutant metals plus molybdenum will be analyzed in ground water samples. The following metals will be analyzed in soil and onshore sediment samples: arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, and zinc. ICP methods (SW 6010) will be used where the quantification limits presented in Tables 8 and 10 of the Work Plan can be achieved. If lower detection limits are needed to meet the tabulated goals, then the corresponding AA methods (SW series 7000) will be used. Ground water samples

will be digested using SW 3005; soil and onshore sediment samples will be digested using SW 3050.

The metals to be analyzed in the marine sediment samples are those listed in the PSEP protocols (Tetra Tech, 1986a,b,c): Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Ag, and Zn. Either SW 6010 (ICP) or SW 7000 (AA) methods will be used to achieve the detection limits listed in Table 10 of the Work Plan.

Total Petroleum Hydrocarbons (TPH) will be analyzed in two ways. EP 418.1 will be used to quantify TPH present in the sample, while SW 8020 (GC/FID scan) will be used to identify the petroleum fraction present.

Six of the ground water samples (2 from each water-bearing zone) will be analyzed for major cations and anions to characterize the general water quality in the aquifers. These analytes will include: aluminum, calcium, potassium, magnesium, and sodium, analyzed by either SW 6010 or 7000, chloride and sulfate analyzed by EP 300.0 (IC), and alkalinity analyzed by EP 310.1 (titration).

Samples of ditch and seep precipitates will be analyzed for metals and additional cations and anions including aluminum, calcium, and magnesium, analyzed by SW 6010, and carbonates, chloride, and total sulfur, analyzed by standard laboratory procedures for identification purposes rather than quantification purposes.

In addition to the organic and inorganic parameters described above, the marine sediment samples will be analyzed for the following conventional parameters useful in data interpretation, as described by the PSEP protocols (Tetra Tech, 1986a): total volatile solids, total organic carbon, percent solids, total sulfides, ammonia, and grain size.

Instances may arise where high sample concentrations, non-homogeneity of samples, or matrix interferences preclude achieving the desired detection limits and associated quality control criteria. In such instances, Landau will require the laboratory to report the reason for deviations from these detection limits or noncompliance with quality control criteria.

For each analysis, the following will be specified:

- o Parameter name;
- o Reference and method numbers;
- o A brief description of the method;
- o The matrix applicable to that method;
- o Detection limit;
- o Target spike recovery as a percentage;
- o Target known recovery as a percentage; and
- o Target RPD for duplicate or replicate analyses.

## 7.0 DATA REDUCTION, VALIDATION, AND REPORTING

All analyses performed for this project must be accompanied by sufficient QC results to enable reviewers to conclusively determine the quality of the data. The Landau QAO or designee is responsible to the Project Manager for conducting checks for internal consistency, transmittal errors, laboratory protocols, and for complete adherence to the QC elements specified in this QAPjP.

Field measurements (e.g., temperature) will be verified and checked through review of measurement and recording procedures during surveillance of field and instrumentation calibration procedures. Transfer of field data from field notebooks to raw data lists will be verified by the Landau QAO.

Analytical data will be reported in the units specified in Tables 4-2, 4-4, and 4-6 of the Work Plan. These units have been selected to assure ease of comparison with previously generated relevant site data and human health criteria.

The laboratory will provide documentation including the sample results with appropriate annotations, and all QA/QC results associated with that sample set (blanks, laboratory duplicates, matrix spikes, matrix spike duplicates, and surrogate recoveries). Raw data, including mass spectra and instrument tuning and calibration data, will not be required for all samples; however, the laboratory will maintain this information in their files. Data validation procedures will include checking the following:

- o Holding times,
- o Field trip blanks,
- o Field rinsate blanks,
- o Blind field duplicates,
- o Laboratory matrix spikes,
- o Laboratory matrix spike duplicates,
- o Method blanks,
- o Surrogate recoveries,
- o Detection limits,
- o Assessment of precision,
- o Assessment of accuracy, and
- o Assessment of completeness.

Section 11.0 presents statistical tests used to determine data precision, accuracy, and completeness. If precision or accuracy fall outside of established acceptance limits, re-analysis or corrective action will be implemented as appropriate. All corrective action will be substantial and defensible, or the corrected data will not be used. Corrective action procedures are presented in Section 12.0.

## 8.0 INTERNAL QUALITY CONTROL

QC checks will consist of measurements performed in the field and laboratory. Analytical procedures referenced in Section 6.0 specify routine methods required to evaluate whether data are within proper QC limits. Additional QC checks include analysis of a number of field and laboratory QC samples, which are described in the following subsections.

### 8.1 FIELD/INTERLABORATORY METHODS

The following QC samples will be evaluated to verify accuracy and precision of analytical results for this investigation. The frequency of field QC analysis is described in Table B-5. The frequency of laboratory QC analysis is described in the approved methods and herein. Table B-6 lists the frequency of matrix spike and matrix spike duplicate samples.

#### Field Trip Blank

Field trip blanks for ground water sampling will consist of a deionized (DI)/distilled water blank (supplied by the analytical laboratory), which will be transported to and from the field, then returned to the laboratory unopened and unaltered for volatile organics analysis to determine possible contamination. One trip blank will be included in each cooler containing ground water samples for volatile analysis.

#### Field Rinsate Blank

Field rinsate blanks will consist of DI/distilled water (supplied by the analytical laboratory) passed over and/or through decontaminated sampling equipment. Surfaces and materials exposed during actual sampling will be rinsed to evaluate the effectiveness of sampling equipment decontamination procedures and potential for equipment or field cross contamination. A minimum of 5 percent of the total number of ground water, soil, and sediment samples analyzed for volatile and semi-volatile organics, PCBs, pesticides, formaldehyde, and metals will be collected as rinsate blanks.

#### Blind Field Duplicate

The field duplicate for soil and sediment samples will consist of split samples from a larger, homogenized sample for semi-volatile, PCB, pesticide, and metal analyses. Samples for volatile analysis will be collected sequentially from adjacent material. The field duplicate for ground water samples will be collected sequentially. Samples will be coded such that the laboratory cannot discern from the sample label which samples are duplicates. Field duplicate samples will be collected at a rate of 5 percent of the total number of samples collected for volatile, semi-volatile, PCB, pesticide, formaldehyde, and metals analyses.

### Performance Evaluation Samples

Performance evaluation samples will consist of commercially prepared samples containing a known composition of an analyte. These samples will be labeled as samples and included with sample shipments to the laboratory from the field. They provide a measure of data accuracy. A minimum of 5 percent of the marine sediment samples will be performance evaluation samples analyzed for semi-volatile organics, PCBs, and pesticides.

### Laboratory Matrix Spike

For each sample matrix, a minimum of one laboratory matrix spike will be analyzed per 20 samples (or one per sampling event, if fewer than 20 samples are obtained) for volatile and semi-volatile organics, PCBs, pesticides, formaldehyde, and metals. These analyses will be performed to provide information on accuracy and assure that extraction and concentration levels are acceptable. The laboratory matrix spike will follow EPA matrix spike guidelines specified in the CLP SOWs, where available.

### Laboratory Matrix Spike Duplicate

For each sample matrix, a minimum of one laboratory matrix spike duplicate will be analyzed per 20 samples (or one per sampling event if fewer than 20 samples are obtained) for volatile and semi-volatile organics, PCBs, pesticides, formaldehyde, and metals. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory duplicate matrix spike will follow EPA duplicate matrix spike guidelines specified in the CLP SOWs, where available.

### Laboratory Method Blank

A minimum of one laboratory method blank will be analyzed for all parameters per 20 samples, one every 12 hours, or one per batch of samples analyzed (if fewer than 20 samples are analyzed) to assess possible laboratory contamination. Dilution water will be used whenever possible. Method blanks will contain all reagents used for analysis.

## **8.2 INTERLABORATORY COMPARISONS**

No interlaboratory comparisons will be required. Accuracy of the analyses will be evaluated based on the results of the performance evaluation samples, blanks, matrix spikes, and other QC sample analyses. A limited number of samples may be split with EPA or Ecology, if requested, which will provide interlaboratory comparisons when analyzed.

## 9.0 PERFORMANCE AND SYSTEM AUDITS

This section presents the internal performance and systems audits required to monitor performance of the laboratory and field measurement systems. Performance and system audits of sampling activities and laboratory operations will consist of direct observations of work being performed, and inspection of laboratory and sampling equipment use, calibration, and maintenance to verify adherence to QA/QC requirements.

Internal audits of both field and laboratory activities will be conducted by the Landau QAO or designee once during sampling or analysis. Audits will be unannounced to assure representative performance of technical and QA procedures.

Checklists for both field and laboratory audits will be based on National Enforcement Investigation Center (EPA, 1984) audit checklists as presented in Appendix D. The audit will be conducted only by individuals that have no direct responsibilities for the activities being audited.

Prior to internal audits, the auditor(s) will meet with the audited party to define the scope of the audit. The physical audit will consist of reviewing audited activities, completing the checklist, and noting any nonconformances, deficiencies, and relevant observations. An exit review will be conducted with the audited party to notify them of preliminary audit findings.

The auditor or designee will prepare an audit report that includes findings, nonconformances, observations, recommended corrective action, and a schedule for completion of such action. The Audit Report Format is presented in Table B-7.

For each identified nonconformance, a Corrective Action Report will be issued as part of the audit report by the auditor to notify the responsible party (the individual responsible for implementing corrective action) of the recommended corrective action and its schedule for completion (see Section 12.0). If a field corrective action is required, the Landau Field Coordinator will be notified. If a laboratory corrective action is required, the Laboratory QA Officer will be notified. The audit report will be distributed to the Landau Project Manager.

The audit will remain open until all corrective action is completed by the responsible party and approved by the Landau QAO. Once all findings are corrected and documented on Corrective Action Reports, the audit will be closed by the Landau QAO. Closure may be effected by either a memo to be filed with the audit report, or by another appropriate method.

## 10.0 PREVENTIVE MAINTENANCE

### 10.1 FIELD INSTRUMENTS

Preventive maintenance on field instruments will be performed by qualified field technicians in accordance with manufacturer's instructions and maintenance schedules. Maintenance will be documented in instrument log books, and will include the date and initials of the individual performing the maintenance.

### 10.2 LABORATORY INSTRUMENTS

The analytical laboratory manager has ultimate responsibility for maintaining laboratory instruments in good working order, including responsibilities for routine maintenance and the training of personnel in maintenance procedures. All maintenance activities and other appropriate details will be documented daily in maintenance log books by the laboratory personnel performing the maintenance. Each entry will be signed and dated. At a minimum, the preventive maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

## 11.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Analytical data will be reviewed to assure that the QA/QC objectives for precision, accuracy, and completeness are met. These reviews are intended to identify the occurrence of deficiencies in time to take corrective action. This section describes routine procedures for assessing project data.

### 11.1 ASSESSMENT OF PRECISION

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that test precision include field duplicates and matrix spike duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), and is calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where:  $D_1$  = First sample value

$D_2$  = Second sample value (duplicate)

The RPDs will be routinely calculated and compared with DQOs.



To set control limits, the standard deviation,  $s$ , of a series of replicate measurement limits is calculated:

$$s = \sqrt{\sum_{i=1}^n \left[ \frac{(X_i - \bar{X})^2}{n-1} \right]^{1/2}}$$

Where:  $s$  = the sample standard deviation

$n$  = the number of replicates

$X_i$  = the  $i$ th replicate

$\bar{X}$  = the mean of the replicates

## 11.2 ASSESSMENT OF ACCURACY

Accuracy is assessed using results of surrogate recoveries, performance evaluation samples, and matrix spike analyses and is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against data quality objectives.

## 11.3 ASSESSMENT OF COMPLETENESS

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with DQOs.

## 12.0 CORRECTIVE ACTIONS

Corrective actions may be needed for two categories of non-conformance:

- o Deviations from the methods or QA requirements established in the QAPjP, and
- o Equipment or analytical malfunctions.

Corrective action procedures that might be implemented based on audit results or detection of unacceptable data are developed on a case-by-case basis. Such actions may include one or more of the following:

- o Altering procedures in the field,
- o Using a different batch of containers,

- o Performing an audit of field or laboratory procedures,
- o Reanalyzing samples if holding times allow,
- o Resampling and analyzing,
- o Evaluating sampling and analytical procedures to determine possible causes of the discrepancies,
- o Accepting the data with no action, acknowledging the level of uncertainty, and
- o Rejecting the data as unusable.

During field operations and sampling procedures, the Landau Field Coordinator will be responsible for taking and reporting required corrective action. A description of any such action taken will be entered in the Daily Field Log. If field conditions are such that conformance with the QAPjP is not possible, the Project Manager will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPjP or Sampling Plan will be communicated to the Port of Tacoma Project Manager for review and concurrence. This communication will be made prior to changes in the field activities whenever possible.

During laboratory analysis, the Laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in this QAPjP, corrective action will follow the guidelines in the CLP SOWs (EPA, 1987, 1988a), the EPA methods and the EPA guidelines for data validation for organics and inorganics (EPA, 1988b,c). At a minimum, the laboratory QA officer will be responsible for monitoring the following:

- o Calibration check compounds must be within performance criteria specified in the EPA method or corrective action must be taken prior to initiation of sample analysis. No analyses may be performed until these criteria are met.
- o Before processing any samples, the analyst should demonstrate, through analysis of a reagent blank, that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

Method blanks must be below quantitation limits specified in the method. If contaminants are present above these levels, the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank re-analyzed. If, upon re-analysis, blanks do not meet these requirements, the Landau QAO will be notified immediately to discuss whether analyses may proceed.

- o Surrogate spike analysis must be within the specified range for recovery limits or corrective action must be taken and documented. Corrective action includes: 1) reviewing calculations, 2) checking surrogate solutions, 3) checking internal standards,

and 4) checking instrument performance. Subsequent action could include recalculating the data and/or re-analyzing the sample if any of the above checks reveal a problem. If the problem cannot be corrected through re-analysis, the QAO will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate.

If the recovery of a surrogate compound in the method blank is outside the recovery limits, the blank will be re-analyzed along with all samples associated with that blank. If the surrogate recovery is still outside the limits, the Landau QAO will be notified immediately to discuss whether analyses may proceed.

- o If holding times are exceeded, all positive and non-detected results will be qualified as estimated concentrations. If holding times are grossly exceeded, the Landau QAO may determine the data to be unusable.
- o If laboratory instrumentation deviates from required calibration specifications, the Landau QAO will either flag data as estimated or determine it to be unusable, according to guidelines established by EPA (EPA, 1988b,c).

If analytical conditions are such that non-conformance with this QAPjP is indicated, the Landau QAO will be notified as soon as possible, so that any additional corrective actions can be taken.

Corrective Action Reports will be used to document response to reported non-conformances. These reports may be generated from internal or external audits or from informal reviews of project activities.

The Landau QAO will keep the Landau Project Manager informed of all deviations from the QAPjP, equipment or analytical malfunctions, and any Corrective Action Reports written for the project.

### 13.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

All data packages reported to the Port of Tacoma will include results of the QA workups and conclusions. This QA report will summarize all relevant data quality information.

Final task or investigative reports will contain a separate QA section summarizing data quality information.

#### 14.0 REFERENCES

Tetra Tech, 1986a. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. P.S.E.P.

\_\_\_\_\_, 1986b. Recommended Protocols for Measuring Metals in Puget Sound Water, Sediment, and Tissue Samples. P.S.E.P.

\_\_\_\_\_, 1986c. Recommended Protocols for Measuring Organic Compounds in Puget Sound Sediment and Tissue Samples. P.S.E.P.

U.S. Environmental Protection Agency, 1983. Methods for Chemical Analysis of Water and Wastes.

\_\_\_\_\_, 1984. NEIC Procedures Manual for the Evidence Audit of Enforcement Investigations by Contractor Evidence Audit Teams (EPA-330/9-81-003-R).

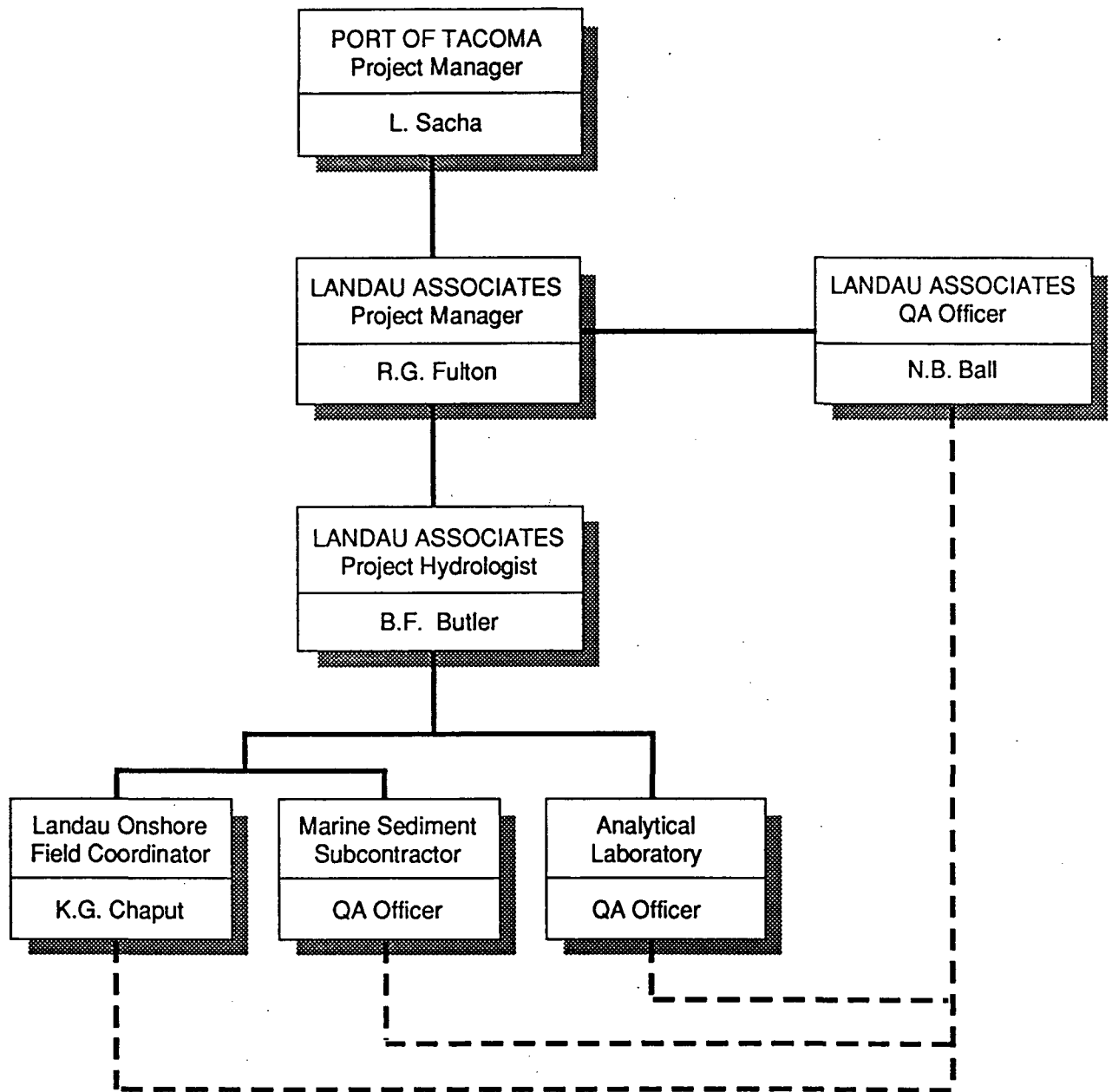
\_\_\_\_\_, 1986. Test Methods for Evaluating Solid Waste (SW 846), 3rd Edition.

\_\_\_\_\_, 1987. Statement of Work for Inorganic Analysis, Multi-media, Multi-concentration, USEPA Contract Laboratory Program.

\_\_\_\_\_, 1988a. Statement of Work for Organic Analysis, Multi-media, Multi-concentration, USEPA Contract Laboratory Program.

\_\_\_\_\_, 1988b. Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis, Hazardous Site Evaluation Division.

\_\_\_\_\_, 1988c. Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis, Hazardous Site Evaluation Division.



# Log of Exploration

Exploration No. \_\_\_\_\_  
Sheet \_\_\_\_\_ of \_\_\_\_\_

Client/ Owner \_\_\_\_\_  
Project No. \_\_\_\_\_  
Exploration No. \_\_\_\_\_  
Start Date \_\_\_\_\_ Hour \_\_\_\_\_  
Ground Surface Conditions \_\_\_\_\_  
Weather Conditions \_\_\_\_\_  
Landau Representative \_\_\_\_\_  
Contractor/Operator \_\_\_\_\_  
Drill Type/Method \_\_\_\_\_  
Hammer Weight & Stroke \_\_\_\_\_

LOCATION SKETCH  
(show dimensions to mapped features)



Surface Elevation \_\_\_\_\_ Datum \_\_\_\_\_

☐ No Recovery

☒ Disturbed Sample

☐ Undisturbed Sample

Sample No.	Sampler Type	Penetration Resistance/6"	Length Driven	Sample Length Recovered	Sample Depth (ft.)	Graphic Recovery	Depth Scale	Unified Symbol	WATER LEVEL INFORMATION	Date	Time	Depth to Water	Hole Depth	Casing Depth	SOIL DESCRIPTION	COMMENTS
							0									
							1									
							2									
							3									
							4									
							5									
							6									
							7									
							8									
							9									
							0									
							1									
							2									
							3									
							4									
							5									
							6									
							7									
							8									
							9									
							0									

Sampler: D/M, SPT, Thinwall (TW), Shelby Tube (S), Bulk (B), etc.  
(Add 'C' to sampler type if a catcher is used)

Finish Date \_\_\_\_\_ Hour \_\_\_\_\_ Cont. ☐

## SAMPLE COLLECTION FORM

SAMPLE NUMBER

Collector \_\_\_\_\_

Proj. Name \_\_\_\_\_ Job No. \_\_\_\_\_

Sample Location &amp; Depth \_\_\_\_\_

Sample Type: Soil, Ground Water, Other \_\_\_\_\_

Date Collected (d/m/yr) \_\_\_\_\_ Time (24-hr.) \_\_\_\_\_

Weather \_\_\_\_\_

Sample Collected With: Bailer; Pump; Split Barrel; Other \_\_\_\_\_

Made of: Stainless Steel; PVC; Teflon; Other \_\_\_\_\_

PURGE DATA Depth to Water (top of PVC): \_\_\_\_\_  
(d/m/y/hr)

Begin \_\_\_\_\_ One Casing Vol. (gal) = \_\_\_\_\_

End \_\_\_\_\_ Gallons Purged = \_\_\_\_\_

(Remove 3 well volumes or until dry)

Description (color, texture, density, moisture, turbidity, etc.)

FIELD	Replicate	pH	Cond. (uS)	Temp.:
PARAMETERS	1	_____	_____	F C
	2	_____	_____	
	3	_____	_____	
	4	_____	_____	

Meter used for measurement: \_\_\_\_\_

Sample composited over time, distance: \_\_\_\_\_

Quantity, types of sample containers: \_\_\_\_\_

Duplicated sample number(s): \_\_\_\_\_

Well Condition: \_\_\_\_\_

(1. Well caps are secure and operational; 2. Visible damage to well)

Comments (why analyze; calculations; etc.)

Signature \_\_\_\_\_ Date (d/m/y) \_\_\_\_\_

9/87

LANDAU ASSOCIATES, INC. (206) 778-0907		LAB NO.
PROJECT #:		DATE:
SAMPLE I.D. #:		TIME:
SAMPLER:		DEPTH:
LOCATION:		
ANALYSIS:		
SPECIAL INSTRUCTIONS/PRESERVATIVES:		



Date \_\_\_\_\_  
Page \_\_\_\_\_ of \_\_\_\_\_

[illegible]

---

### Chain of Custody Seal

Person Collecting Sample \_\_\_\_\_ (signature) No. of Samples \_\_\_\_\_

Date Sealed \_\_\_\_\_ Time Sealed \_\_\_\_\_

Location \_\_\_\_\_

\_\_\_\_\_

---

TABLE B-1

QUALITY ASSURANCE RESPONSIBILITIES

<u>Personnel</u>	<u>Responsibilities</u>
Robert G. Fulton: Project Manager Landau	Oversee technical project team performance to ensure successful accomplishment of technical and QA project objectives. Review project QA needs and approve appropriate QA corrective actions as needed.
Nancy B. Ball: Project QA Officer Landau	Direct implementation of QAPjP; arrange contract or other external procurement packages for QA needs; prepare corrective action response; evaluate data and prepare Data Validation Report; prepare and submit QA reports to project management; review QA report generated by subcontractor, and conduct or supervise laboratory and field audits.
Wally Trial: Marine Sediment Subcontractor QA Officer Herrera, Inc.	Ensure that all field and sample handling activities are documented and field QA objectives are met during collection of marine sediment samples; notify Project QA officer of any deviations from the QAPjP; evaluate data and prepare Data Validation Report on marine sediment samples.
K.G. Chaput: Field Coordinator Landau	Ensure that all field and sample handling activities are documented and field QA objectives are met during collection of ground water, soil, and onshore sediment samples; notify Project QA officer of any deviations from the QAPjP.
_____ Laboratory QA Officer	Ensure that all laboratory QA objectives are met and laboratory QA/QC information is properly documented and reported.

TABLE B-2

## SURROGATE RECOVERY CONTROL LIMITS

Fraction/Surrogate Name	Control Limits (percent)
=====	
Semi-volatiles by GC/MS, 8270	
Matrix: Soil	
2-Fluorophenol	25-121
d5-phenol	24-113
d5-Nitrobenzene	23-120
2-Fluorobiphenyl	30-115
2,4,6-Tribromophenol	19-122
d14-p-Terphenyl	18-137
Matrix: Water	
2-Fluorophenol	21-100
d5-phenol	10-94
d5-Nitrobenzene	35-114
2-Fluorobiphenyl	43-116
2,4,6-Tribromophenol	10-123
d14-p-Terphenyl	33-141
Pesticides/PCBs by GC/ECD, 8080	
Matrix: Soil	
Dibutylchloredate(a)	24-154
Matrix: Water	
Dibutylchloredate(a)	20-150
Volatiles by GC/MS, 8240	
Matrix: Soil	
p-Bromofluorobenzene	74-121
d4-1,2-Dichloroethane	70-121
d8-Toluene	81-117
Matrix: Water	
p-Bromofluorobenzene	86-115
d4-1,2-Dichloroethane	76-114
d8-Toluene	88-110

---

(a) Advisory control limit only.

TABLE B-3

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE CONTROL LIMITS

Fraction/Surrogate Name	Control Limits	
	Recovery (percent)	RPD (percent)
=====		
Semi-volatiles by GC/MS, 8270		
-----		
Matrix: Soil		
Phenol	26- 90	35
2-Chlorophenol	25-102	50
1,4-Dichlorobenzene	28-104	27
N-Nitroso-di-n-Propylamine	41-126	38
1,2,4-Trichlorobenzene	38-107	23
4-Chloro-3-Methylphenol	26-103	33
Acenaphthene	31-137	19
4-Nitrophenol	11-114	50
2,4-Dinitrotoluene	28- 89	47
Pentachlorophenol	17-109	47
Pyrene	35-142	36
Matrix: Water		
Phenol	12- 89	42
2-Chlorophenol	27-123	40
1,4-Dichlorobenzene	36- 97	28
N-Nitroso-di-n-Propylamine	41-116	38
1,2,4-Trichlorobenzene	39- 98	28
4-Chloro-3-Methylphenol	23 -97	42
Acenaphthene	46-118	31
4-Nitrophenol	10- 80	50
2,4-Dinitrotoluene	24- 96	38
Pentachlorophenol	9-103	50
Pyrene	26-127	31
Pesticides/PCBs by GC/ECD, 8080		
-----		
Matrix: Soil		
Lindane	46-127	50
Heptachlor	35-130	31
Aldrin	34-132	43
Dieldrin	31-134	38
Endrin	42-139	45
4,4-DDT	23-134	50
Matrix: Water		
Lindane	56-123	15
Heptachlor	40-131	20
Aldrin	40-120	22
Dieldrin	52-126	18
Endrin	56-121	21
4,4-DDT	38-127	27

TABLE B-3 (continued)

## MATRIX SPIKE/MATRIX SPIKE DUPLICATE CONTROL LIMITS

Fraction/Surrogate Name	Control Limits	
	Recovery (percent)	RPD (percent)
=====		
Volatiles by GC/MS, 8240		
-----		
Matrix: Soil		
1,1-Dichloroethane	59-172	20
Trichloroethylene	62-137	20
Benzene	66-142	20
Toluene	59-139	20
Chlorobenzene	60-133	20
Matrix: Water		
1,1-Dichloroethane	61-145	20
Trichloroethylene	71-120	20
Benzene	76-127	20
Toluene	76-125	20
Chlorobenzene	75-130	20
Metals, 6010 or 7000 series		
-----		
Matrix: Soil		
Arsenic	75-125	20
Barium	75-125	20
Cadmium	75-125	20
Chromium	75-125	20
Copper	75-125	20
Iron	75-125	20
Lead	75-125	20
Manganese	75-125	20
Nickel	75-125	20
Zinc	75-125	20
Matrix: Water		
Antimony	75-125	20
Arsenic	75-125	20
Cadmium	75-125	20
Chromium	75-125	20
Copper	75-125	20
Iron	75-125	20
Lead	75-125	20
Manganese	75-125	20
Mercury	75-125	20
Molybdenum	75-125	20
Nickel	75-125	20
Selenium	75-125	20
Silver	75-125	20
Thallium	75-125	20
Zinc	75-125	20

TABLE B-4  
ANALYTICAL PROCEDURES

Analyte	Procedure	Sample Matrix
Semi-volatile Organics	SW 8270	Onshore sediments, marine sediments
Pesticides/PCBs	SW 8080	Ground water, soils, onshore sediments, marine sediments
Formaldehyde	Lab SOP <sup>(a)</sup>	Ground water
Metals (As, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Mo, Ni, Zn)	SW 6010 <sup>(b)</sup> SW 7000 series	Ground water, soils, precipitates, onshore sediments
Metals (Sb, As, Cd, Cu, Pb, Mn, Hg, Ni, Ag, Zn)	SW 6010 <sup>(b)</sup> SW 7000 series	Marine sediments
TPH	EP 418.1 <sup>(c)</sup> SW 8020	Ground water, soils, onshore sediments
Cations/Anions (Al, Ca, K, Mg, Na) (Cl, SO <sub>4</sub> ) Alkalinity	SW 6010 <sup>(b)</sup> SW 7000 series EP 300.0 EP 310.1	Ground Water
Cations/Anions (Al, Ca, Mg, CO <sub>3</sub> , Cl, S)	SW 6010 Lab SOP <sup>(d)</sup>	Precipitates
Conventional Parameters: Total Volatile Solids Total Organic Carbon Percent Solids Total Sulfides Ammonia Grain Size	PSEP <sup>(e)</sup>	Marine sediments

(a) Procedure based on ASTM proposed method for formaldehyde in water (procedure attached in Appendix C.)

(b) If detection limits specified in Tables 3-5, 4-2, and 4-4 cannot be achieved using SW 6010, then the corresponding 7000 series AA graphite furnace method will be used.

(c) EP 418.1 will be used for quantification of TPH and SW 8020 will be used to identify the petroleum fraction present.

(d) Analysis of cations and anions on precipitate samples is for identification purposes only.

(e) Tetra Tech, 1986a.

TABLE B-5  
FIELD QC SAMPLES

Sample Matrix	No. of Samples	Field Duplicates	Equipment Blanks	Drillers Blanks	Trip Blanks
=====					
<u>Ground Water</u>					
Metals	20	1	1 (pump)	4 (2 each)	0
Volatiles	21	1	1 (pump)	4	1/cooler
Semi-volatiles	20	1	1 (pump)	4	0
PCB/Pesticides	19	1	1 (pump)	4	0
Formaldehyde	19	1	1 (pump)	4	0
TPH & GC/FID	1	0	0	0	0
Major Ions	6	0	0	0	0
 <u>Soils &amp; Onshore Sediments</u>					
Metals	61	3	3 (split spoon)		
Volatiles	36	2	2 (split spoon)		
Semi-volatiles	71	4	4 (split spoon)		
PCB/Pesticides	60	3	3 (split spoon)		
TPH & GC/FID	2	0	0		
Major Ions	3	0	0		
 <u>Marine Sediments</u>					
Metals	23	1	1		
Volatiles	23	1	1		1
Semi-volatiles	23	1	1		
PCB/Pesticides	23	1	1		



TABLE B-6

## FREQUENCY OF MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES

Sample Matrix	MS/MSD
=====	
<u>Ground Water</u>	
Metals	1 pair
Volatiles	1 pair
Semi-volatiles	1 pair
PCB/Pesticides	1 pair
Formaldehyde	1 pair
TPA & GC/FID	0
Major Ions	0
<u>Soils &amp; Onshore Sediments</u>	
Metals	3 pairs
Volatiles	2 pairs
Semi-volatiles	4 pairs
PCB/Pesticides	3 pairs
TPA & GC/FID	0
Major Ions	0
<u>Nearshore Marine Sediments</u>	
Metals	1 pair
Volatiles	1 pair
Semi-volatiles	1 pair
PCB/Pesticides	1 pair

TABLE B-7  
AUDIT REPORT FORMAT

1. Purpose of Audit
2. Audit Basis
3. Time and Place of Audit
4. Personnel Contacted
5. Audit Team Members
6. Summary of Events
7. Findings and Recommendations
  - a. Positive Findings
  - b. Negative Findings
8. Required Follow-up (responsible parties, summary of required corrective action, date of reaudit, if required)
9. Distribution of Audit Report and Corrective Action Reports

APPENDIX C

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# **Proposed Test Method for Formaldehyde in Water**

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Task Group No. 19.06.04.11  
Draft No. two  
Date: January 20, 1987  
TG Chairman Jim Miltimore  
206 924-6456

Proposed Test Method for  
FORMALDEHYDE IN WATER

1. Scope

- 1.1 This test method covers the determination of the formaldehyde monomer concentration in water and wastewater, based on the Hantzsch reaction with acetylacetone in the presence of ammonia to form the yellow compound, 3,5-diacetyl-1,4-dihydro-lutidine.(1)
- 1.2 This test method is suitable for free formaldehyde concentrations in the range of 0.2 to 7.0 mg/L. More concentrated samples should be diluted with distilled water prior to analysis. More dilute samples (0.006 - 0.6 mg/L) may be run using a 10-cm cell.
- 1.3 If greater sensitivity is desired, the reacted samples may be analyzed using fluorescence spectroscopy. The detection limit is approximately 0.01 mg/L using this technique.(2)
- 1.4 This test method was used successfully with reagent water and wastewater. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.
- 1.5 Formaldehyde polymers react partially and/or slowly, making this test method unsuitable for analysis of these compounds.
- 1.6 This test method may involve hazardous materials, operations, and equipment. This test method does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific precautionary statements, see section 9.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 1129 Definitions of Terms Relating to Water (3)
- D 1192 Specification for Equipment for Sampling Water and Steam (3)
- D 1193 Specification for Reagent Water (3)
- D 1293 Test Methods for pH in Water (3)
- D 2777 Practice for Determination of Precision and Bias of Methods of Committee D-19 on Water (3)
- D 3370 Practices for Sampling Water (3)
- D 3856 Practice for Evaluating Laboratories Engaged in Sampling and Analysis (3)
- D 4210 Practice for Intralaboratory Quality Control Procedures and a Discussion on Reporting Low-Level Data (3)
- E 60 Recommended Practice for Photometric Methods for Chemical Analysis of Metals (4)
- E 200 Method for Preparation, Standardization, and Storage of Standard Solutions for Chemical Analysis (3)
- E 275 Recommended Practice for Describing and Measuring Performance of Spectrophotometers (5)

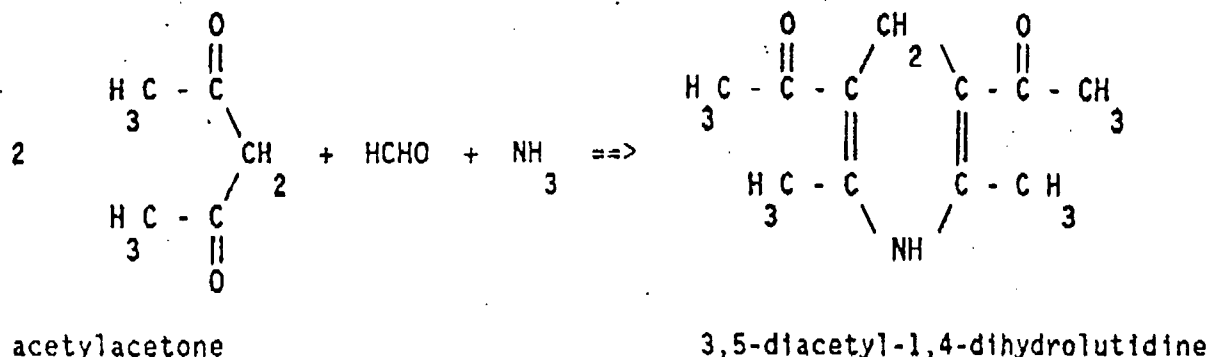
## 3. Definitions

- 3.1 For definitions of terms used in this test method, refer to Definitions D 1129.

## 4. Summary

- 4.1 An aliquot of the sample containing 0.2 - 7 mg/L of formaldehyde is combined with an equal volume of the acetylacetone reagent in a test tube. The tube is capped, shaken, and reacted at 60 C for 10 minutes. After cooling, the absorbance of the solution is read at 412 nm. Colored or turbid samples are extracted with n-butanol prior to reading the absorbance, and the reading is then taken on the n-butanol extract. Concentration is calculated from a curve of standard formaldehyde solutions.

4.2 The chemical reaction involved is as follows:



## 5. Significance and Use

5.1 This test method is used to determine the concentration of formaldehyde monomer which is present in water, without many of the problems associated with other methods. The equipment required is fairly simple, so the test can be performed under near field conditions. Because of the near neutral pH of the reagents, the mild reaction conditions result in very little destruction or formation of free formaldehyde. The reagents are not affected by nitrates or reducing agents.

## 6. Interferences

- 6.1 Samples that are colored or turbid after reacting may interfere. The butanol extraction described in the procedure removes the desired lutidine yellow color from these interferences.
- 6.2 Acetaldehyde gives rise to diacetyldihydrocollidine which has an absorption peak at 388 nm, and will overlap the diacetyldihydrolutidine. Ethylene glycol forms formaldehyde under these reaction conditions. Amines can compete with the reaction, causing negative interferences. Periodate destroys the color, but this can be prevented by additions of iodine and thiosulfate. (6)
- 6.3 Formaldehyde polymers, except paraformaldehyde, give very little interferences.
- 6.4 Phenols, sulfites and other reactive substances combine with free formaldehyde to form other compounds. Such bound formaldehydes are not meant to be measured by this test.

## 7. Apparatus

- 7.1 Photometer (7) - A spectrophotometer or filter photometer, suitable for use at 412 nm.

- 7.2 Heating block or water bath for test tubes which can be regulated to  $60 \pm 3$  C.
- 7.3 Borosilicate test tubes with teflon-lined screw caps.
- 7.4 Centrifuge with capped tubes.
- 7.5 Buret, 50-mL.
- 7.6 Magnetic stirrer and stir bars.
- 7.7 pH meter which shall conform to the requirements of test method D 1293.

## 8. Reagents

- 8.1 Purity of Reagents - Reagent grade chemicals shall be used for all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society(8), where such specifications are available. Other grades may be used, provided that it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.
- 8.2 Purity of Water - Unless otherwise indicated, references to water used shall be understood to mean reagent water conforming to Type I or Type II of Specification D 1193. Water for this test method shall be free of formaldehyde, residual chlorine, phenolic compounds, and substances that interfere with this test.
- 8.3 Acetic Acid Glacial (sp gr 1.05)
- 8.4 Acetylacetone (C H O ) (Also known as 2,4-pentanedione)
- 8.5 Acetylacetone Reagent - Weigh 154 g of ammonium acetate into a 400-mL beaker. Dissolve the crystals in a small volume of water. Transfer the solution quantitatively to a 1 liter volumetric flask. Add 2 mL of acetylacetone and 3 mL of glacial acetic acid to the flask. Add enough water to mix thoroughly, and dilute to 1 liter. Store the solution in a brown glass container at 4 C.
- 8.6 n - Butanol (optional - for colored or turbid samples).
- 8.7 Formaldehyde - (37%) or Paraformaldehyde flakes.
- 8.8A Formaldehyde Stock Solution - (1000 mg/L) Suspend 1.07 g of para-formaldehyde in 200 mL of water. Heat the suspension to boiling to dissolve the crystals. Cool and filter the solution. Dilute to 1 liter. Calibrate using the procedure described in section 11.1. The solution should be stored at room temperature, in the dark, and should be standardized every 6 months. The solution appears to stable indefinitely.

- 8.8B Alternate Formaldehyde Stock Solution - (1000 mg/L) Dilute 2.7 mL of commercially available 37% formaldehyde solution to 1 liter with water. Calibration, storage, and stability are as for section 8.8A.
- 8.9 Formaldehyde Standard Solution - (10.0 mg/L) Dilute 1 mL of the formaldehyde stock solution to 100 mL with water. Prepare fresh daily.
- 8.10 Hydrochloric Acid (sp gr 1.19)-Concentrated hydrochloric acid (HCl).
- 8.11 Hydrochloric Acid - (1.0 N) - Prepare as directed in Method E 200.
- 8.12 Hydrochloric Acid - (0.1 N), standardized solution - Prepare and standardize as directed in Method E 200.
- 8.13 Sodium Sulfite Solution - (1.0 M) freshly prepared  
Dissolve 31.5 g of anhydrous sodium sulfite in 150 mL of water, and dilute to volume in a 250-mL volumetric flask. Adjust to pH 9.5 with the 1 N hydrochloric acid (only a few drops).
9. Safety Precautions
- 9.1 Glacial acetic acid can produce skin burns and severely injure the eyes. It is also flammable.
- 9.2 Acetylacetone is a mild irritant to the skin and mucous membranes.
- 9.3 n-Butanol is a skin and eye irritant, and is flammable. It may also cause inhalation irritation and should be handled in a hood.
- 9.4 Formaldehyde is a severe irritant to skin, eyes, and mucous membranes and can cause severe hypersensitivity. It may also be a potential carcinogen. It is a moderate fire hazard. Protection should be taken to avoid inhalation of the vapors, and skin contact.

## 10. Sampling

- 10.1 Collect the sample in accordance with Specification D 1192 and Practices D 3370.

## 11. Calibration

### 11.1 Calibration of the Stock Solution - Procedure

- 11.1.1 Calibrate pH meter with the standard 7.0 and 10.0 buffers.
- 11.1.2 Pipet 50.0 mL of the formaldehyde stock solution in a 125-mL Erlenmeyer flask, and add 20.0 mL of sodium sulfite solution.
- 11.1.3 Cap and allow the mixture to stand for 5 minutes.
- 11.1.4 Add a magnetic stir bar, and place solution on magnetic stirrer.
- 11.1.5 Titrate rapidly to a stable endpoint of pH 9.5 with the 0.1 N hydrochloric acid from the buret.



11.1.6 Calculate the concentration of the formaldehyde stock solution as follows:

$$\text{mg HCHO/mL} = \frac{(\text{mL of HCl titrant})(\text{Normality of HCl})(30.03)}{(\text{mL of stock formaldehyde})}$$

11.1.7 Perform three replications and calculate the mean concentration. Replicates should agree to within 0.3 percent.

## 11.2 Standard curve preparation

11.2.1 Prepare a series of standards by adding the specified aliquots of the standard solution (8.9) and water to the test tubes (volumes given are for a 2 mL standard):

Conc (mg/L)*	mL Std (10.0 mg/L)	mL water
0	0	2.0
0.50	0.1	1.9
1.50	0.3	1.7
2.50	0.5	1.5
3.50	0.7	1.3
4.50	0.9	1.1
6.00	1.2	0.8
7.50	1.5	0.5

\* Actual concentration will depend on the calibration of the stock solution. These calculations assume a stock solution of 1000 mg/L.

11.2.2 Add a volume of the acetylacetone reagent which is equal to the volume of standard to each tube. Cap tightly, shake well, and place the tubes in a heating block at 60 C for 10 minutes. Remove tubes from the block and cool to room temperature.

Note-Volumes of much less than 2 mL increase the relative error of evaporation, aliquoting, etc. Sufficient quantities are also needed to rinse out the spectrophotometer cells. Too much volume may not allow sufficient time for the sample to properly warm.

11.2.3 Zero the spectrophotometer with water. Measure the absorbance of the standard solutions compared to that of water at 412 nm. The color is stable for several hours. Appendix X.1 has a standard curve run in a laboratory.

## 12. Procedure

- 12.1 Samples need to be in the range of 0.2 - 7.0 mg/L. If samples are known to be above this range, a dilution should be made to achieve a concentration within this range. For samples in the range 0.01 - 0.5 mg/L, the volumes of reagents and sample should be increased to 20 mL of each. This will yield sufficient volume to measure the absorbance in a 10 cm-cell.
- 12.2 Pipet an aliquot of each sample (or diluted sample) into a screw-capped test tube. Process samples in the same manner as the standards as described in section 11.2.2 - 11.2.3, using a volume of acetylacetone reagent which is equal to the volume of sample used.
- 12.3 If samples are colored and/or become turbid following the reaction, add a volume of n-butanol to the test tube that is equal to that of the sample plus the reagent. If 2 mL of sample and 2 mL of reagent were used, add 4 mL of n-butanol. Swirl the tube to mix, and transfer the contents to a capped centrifuge tube. Shake the tube for 30 seconds and centrifuge it for 10 minutes. Analyze the upper n-butanol layer in the manner described in section 11.2.3. It may be desirable to analyze the standards in the same manner, as there is a slight loss of color in the extraction process. This loss is proportionately the same for all standards, so the linearity remains.

## 13. Calculations

- 13.1 Calculate the formaldehyde concentration of the samples by reading the mg/L on the standard curve which corresponds to the absorbance of the sample. If a dilution factor was used, the original concentration can be calculated in the following manner:

$$\text{HCHO, mg/L} = \text{Calculated mg/L} \times V / A$$

where:

V = the final dilution volume in mg/L

A = the aliquot used for the dilution in mg/L.

## 14. Report

- 14.1 Report results as:

Free Formaldehyde = \_\_\_\_\_ mg/L

## 15. Precision and Accuracy

- 15.1 The exact precision and accuracy are not known at this time.
- 15.2 Until such time as QA/QC procedures are established, it is recommended that the user use Standard Practice D 4210 and Standard Guide D 3856 as guides for establishing his own QA/QC.
- 15.3 Before this test method is applied to the analysis of samples, the analyst shall establish his own precision and accuracy data.
- 15.4 A duplicate and known standard shall be run each day that an analysis is done. The duplicate and standard shall meet satisfactory limits as established by the control chart before an analysis is considered satisfactory.
- 15.5 A blank and spike shall be run each day that an analysis is done. The spike shall be in accordance with that outlined in section 11.5.4 of Standard Guide D 3856. The blank shall be low enough that it shall not unduly influence the data.
- 15.6 One standard should be run with every 10 analyses or with each batch, whichever results in the greater frequency. The results shall meet satisfactory limits as established by section 15.7 before the data for that batch or set of 10 are acceptable.
- 15.7 Other formal QA/QC procedures will be incorporated at such time as they have been officially accepted by the Society.

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(1) This test method is under the jurisdiction of ASTM Committee D-19 on Water and is under the direct responsibility of Subcommittee D19.06 on Organics.

(2) Berge, A., B. Møllgaard. 1979. Formaldehyde emission from particleboard - a new method for determination. Forest Products Journal 29, 21.

(3) 1986 Annual Book of ASTM Standards, Vol. 11.01.

(4) 1986 Annual Book of ASTM Standards, Vol. 03.05.

(5) 1986 Annual Book of ASTM Standards, Vol. 15.05.

(6) Nash, T. 1953. The colorimetric estimation of formaldehyde by means of the Hantzsch reaction. Biochem. 55, 416.

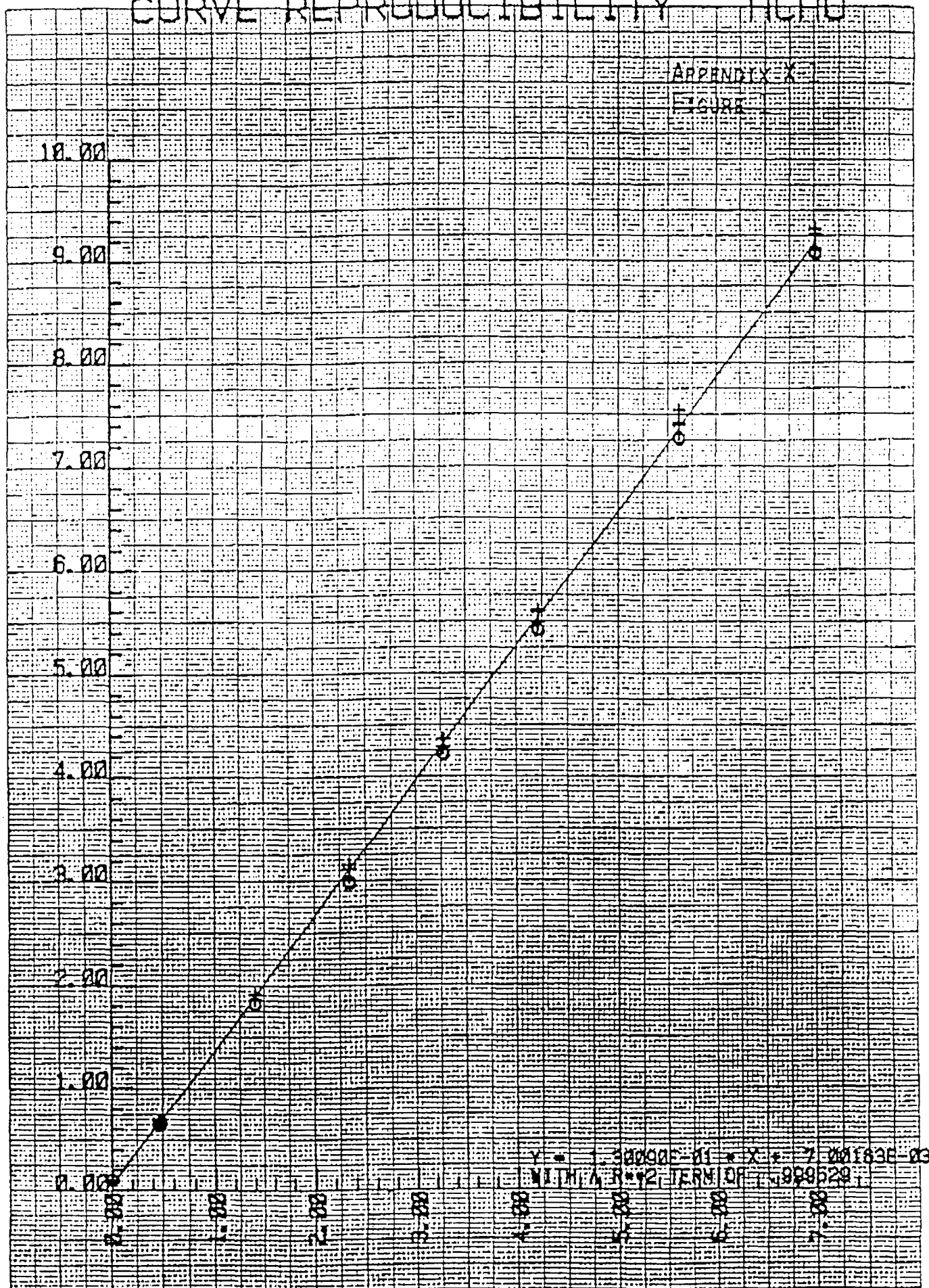
- (7) Filter photometers and photometric practices prescribed in this test method shall conform to Recommended Practice E 60. Spectrophotometers shall conform to Recommended Practice E 275.
- (8) "Reagent Chemicals, American Chemical Society Specification," Am. Chemical Soc., Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."

# CURVE REPRODUCIBILITY HCHO

APPENDIX X  
FIGURE

(\*10\*\*-1)

ABSORBANCE

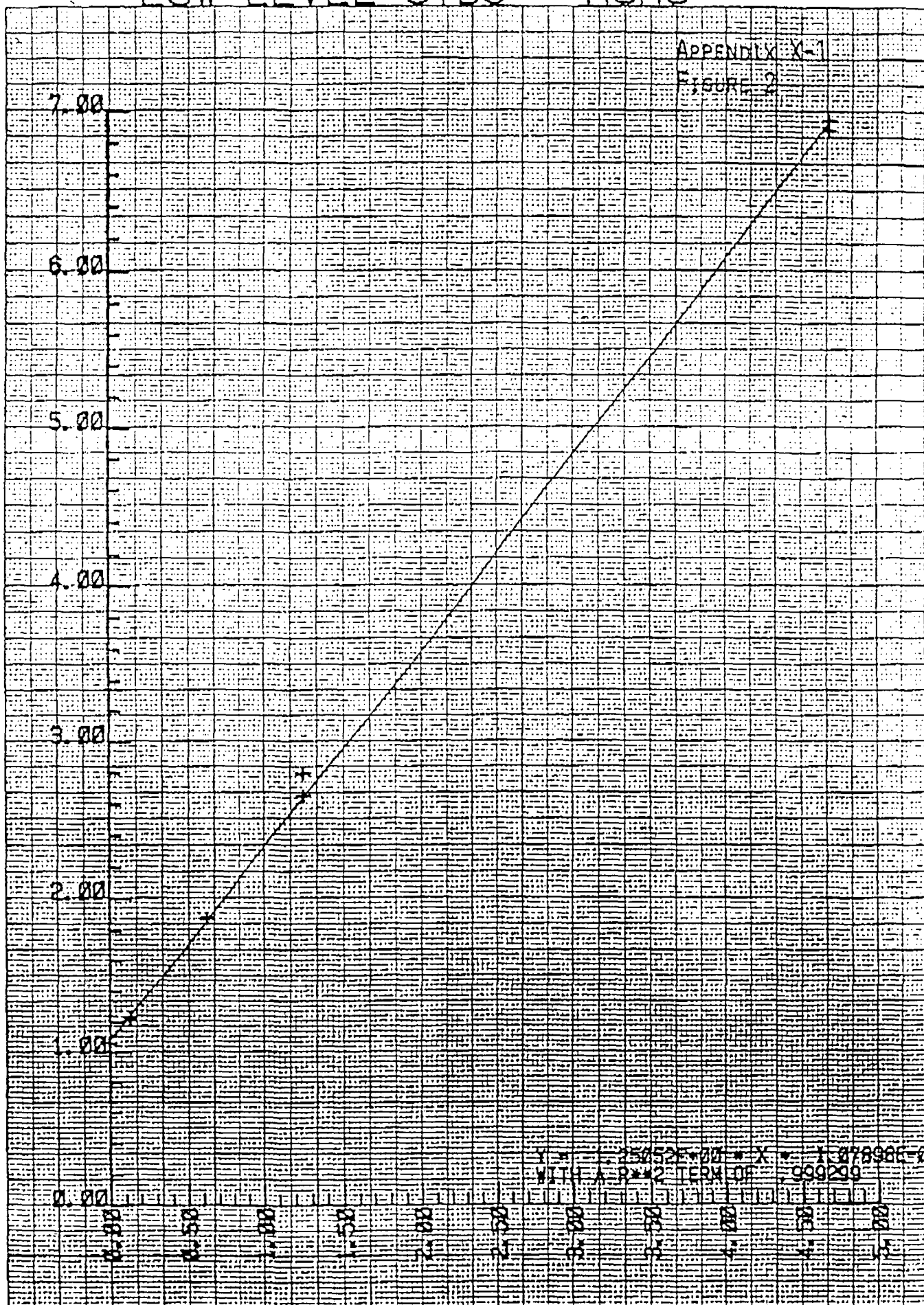


# LOW LEVEL STDS - HCHO

APPENDIX X-1  
FIGURE 2

(\*10\*\*-1)

ABSORBANCE



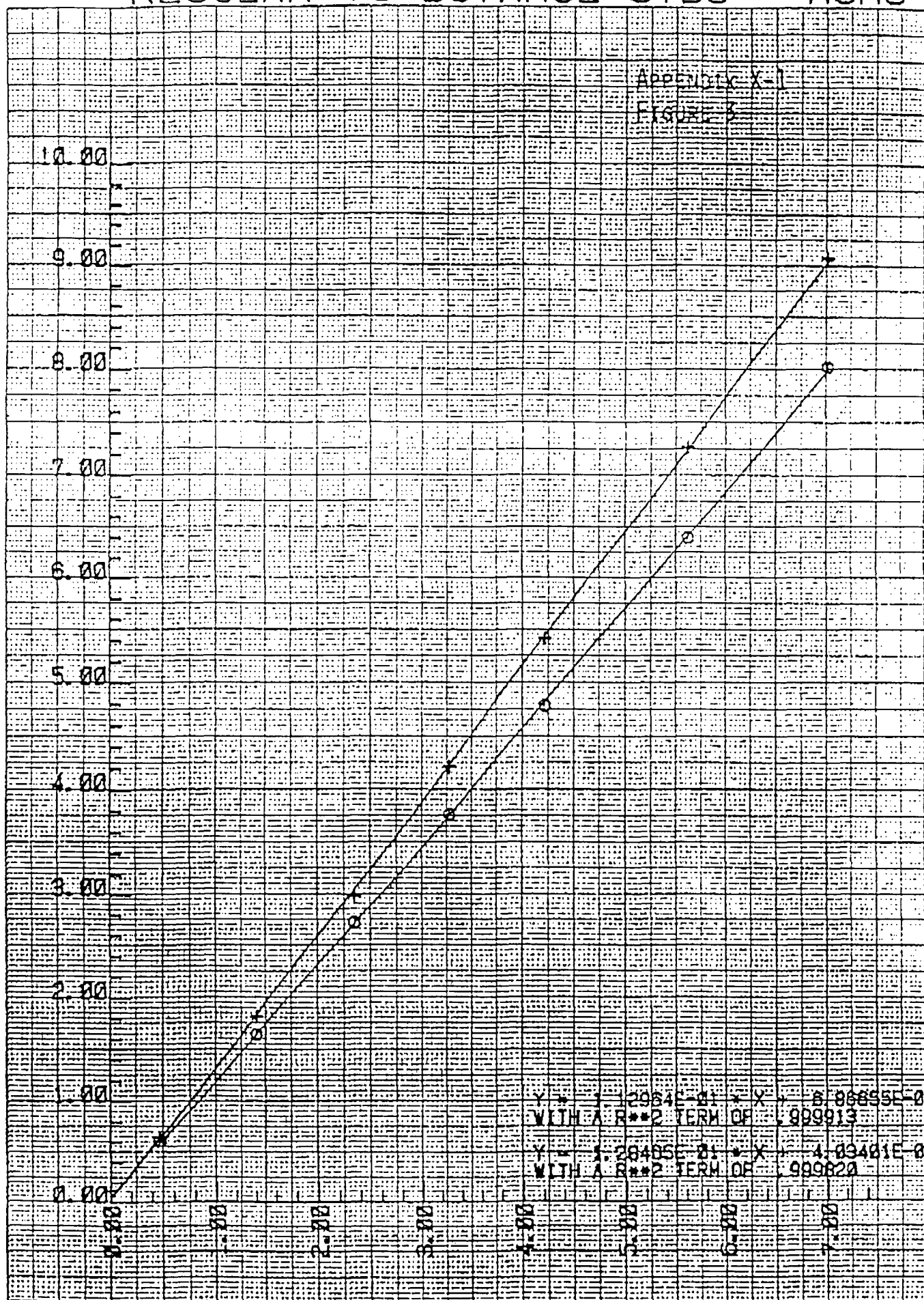
MG/L HCHO C-11

(\*10\*\*-1)

# REGULAR VS BUTANOL STDS - HCHO

(\*10\*\*-1)

ABSORBANCE





APPENDIX D

# Field and Laboratory Audit Checklists



## FIELD AND LABORATORY AUDIT CHECKLISTS

The field and laboratory checklists presented in this Appendix are duplicates of audit checklists used by the EPA's National Enforcement Investigations Center (NEIC 1984) in Denver, Colorado. These checklists have been selected for use of this project because they represent approved EPA audit checklists and reflect a standard of audit review appropriate to the project scope.

Selected audit observations in both the field and laboratory checklist may not be applicable to this project. When completing the audit checklists, the auditors will indicate non-applicable observations by checking the corresponding "N/A" entry on this checklist.

FIELD CHECKLIST  
Field Observations

- Yes\_\_ No\_\_ N/A\_\_    1. Was permission granted to enter and inspect the facility? (Required if RCRA inspection)
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    2. Is permission to enter the facility documented? If yes, where is it documented?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    3. Were split samples offered to the facility? If yes, was the offer accepted or declined?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    4. Is the offering of split samples recorded? If yes, where is it recorded?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    5. If the offer to split samples was accepted, were the split samples collected? If yes, how were they identified?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    6. Are the number, frequency and types of field measurements and observations taken as specified in the project plan or as directed by the project coordinator? If yes, where are they recorded?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_    7. Are samples collected in the types of containers specified for each type of analysis? If no, what kind of sample containers were used?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Yes\_\_ No\_\_ N/A\_\_

8. Are samples preserved as required? If no or N/A, explain.

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Yes\_\_ No\_\_ N/A\_\_

9. Are the number, frequency and types of samples collected as specified in the project plan or as directed by the project coordinator? If no, explain why not?

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Yes\_\_ No\_\_ N/A\_\_

10. Are samples packed for preservation when required (i.e., packed in ice, etc.)? If no or N/A, explain why.

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Yes\_\_ No\_\_ N/A\_\_

11. Is sample custody maintained at all times? How?

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## FIELD CHECKLIST

### Document Control

- Yes\_\_ No\_\_ N/A\_\_ 1. Have all unused and voided accountable documents been returned to the coordinator by the team members?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 2. Were any accountable documents lost or destroyed? If yes, have document numbers of all lost or destroyed accountable documents been recorded and where are they recorded?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 3. Are all samples identified with sample tags? If no, how are samples identified?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 4. Are all sample tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)? If yes, describe types of information recorded.
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 5. Are all samples collected listed on a chain-of-custody record? If yes, describe the type of chain-of-custody record used and what information is recorded.
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- Yes\_\_ No\_\_ N/A\_\_ 6. If used, are the sample tag numbers recorded on the chain-of-custody documents?
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Yes\_\_ No\_\_ N/A\_\_

7. Does information on sample tags and Chain-of-Custody Records match?

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Yes\_\_ No\_\_ N/A\_\_

8. Does the Chain-of-Custody Record indicate the method of sample shipment?

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Yes\_\_ No\_\_ N/A\_\_

9. Is the Chain-of-Custody Record included with the samples in the shipping container?

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Yes\_\_ No\_\_ N/A\_\_

10. If used, do the sample traffic reports agree with the sample tags?

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Yes\_\_ No\_\_ N/A\_\_

11. If required, has a receipt for samples been provided to the facility (required by RCRA)? Describe where offer of a receipt is documented.

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Yes\_\_ No\_\_ N/A\_\_

12. If used, are blank samples identified?

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Yes\_\_ No\_\_ N/A\_\_

13. If collected, are duplicate samples identified on sample tags and Chain-of-Custody Records?

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Yes\_\_ No\_\_ N/A\_\_

14. If used, are spiked samples identified?

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Yes\_\_ No\_\_ N/A\_\_ 15. Are logbooks signed by the individual who checked out the logbook from the project coordinator?

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Yes\_\_ No\_\_ N/A\_\_ 16. Are logbooks dated upon receipt from the project coordinator?

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Yes\_\_ No\_\_ N/A\_\_ 17. Are logbooks project-specific (by logbook or by page)?

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Yes\_\_ No\_\_ N/A\_\_ 18. Are logbook entries dated and identified by author?

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Yes\_\_ No\_\_ N/A\_\_ 19. Is the facility's approval or disapproval to take photographs noted in a logbook?

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Yes\_\_ No\_\_ N/A\_\_ 20. Are photographs documented in logbooks (e.g., time, date, description of subject, photographer, etc.)?

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Yes\_\_ No\_\_ N/A\_\_ 21. If film from a self-developing camera is used, are photos matched with logbook documentation?

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Yes\_\_ No\_\_ N/A\_\_ 22. Are sample tag numbers recorded? If yes, describe where they are recorded.

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Yes\_\_ No\_\_ N/A\_\_ 23. Are calibration of pH meters, conductivity meters, etc., documented? If yes, describe where this is documented.

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Yes\_\_ No\_\_ N/A\_\_ 24. Are amendments to the project plan documented? If yes, describe where the amendments are documented.

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**FIELD CHECKLIST**  
**Debriefing with Project Coordinator**

Yes\_\_ No\_\_ N/A\_\_ 1. Was a debriefing held with project coordinator and/or other participants?

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Yes\_\_ No\_\_ N/A\_\_ 2. Were any recommendations made to the project participants during the debriefing? If yes, list recommendations.

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**LABORATORY CHECKLIST**  
**Debriefing with Laboratory Personnel**

1. List observations made by the auditor.

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2. Make recommendations with respect to each observation.

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3. Discuss observations and recommendations made by the auditor.

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## LABORATORY CHECKLIST

SIGNATURE OF AUDITOR \_\_\_\_\_ DATE OF AUDIT \_\_\_\_\_  
LABORATORY \_\_\_\_\_ CEAT PROJECT NO. \_\_\_\_\_  
LABORATORY LOCATION \_\_\_\_\_  
CONTRACTS IN EFFECT \_\_\_\_\_

(List Contract Numbers)

1. Name of Sample Custodian and other personnel responsible for sample receipt and document control.  
\_\_\_\_\_  
\_\_\_\_\_
2. Where are the Sample Custodian's procedures and responsibilities documented?  
\_\_\_\_\_  
\_\_\_\_\_
3. Where are written Standard Operating Procedures (SOPs) pertaining to receipt of samples documented (laboratory manual, written instructions, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_
4. Where is the receipt of Chain-of-Custody Record(s) with samples being documented?  
\_\_\_\_\_  
\_\_\_\_\_
5. Review sample receipt documentation to assure that the nonreceipt of chain-of-custody record(s) with samples is being documented.  
\_\_\_\_\_  
\_\_\_\_\_
6. Where is the integrity of the shipping container(s) being documented (custody seal(s) intact, container locked or sealed properly, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_

7. Review the sample receipt documentation to assure that the lack of integrity of the shipping container(s) is being documented (i.e., evidence of tampering, custody seals broken or damaged, locks unlocked or missing, etc.)?
- 
- 
8. Determine, by asking the Sample Custodian or reviewing the laboratory SOP manual, if agreement among Sample Management Office forms, chain-of-custody records, and sample tags is being verified? State source of information.
- 
- 
9. Where is the agreement or nonagreement verification being documented?
- 
- 
10. Review sample receipt documentation to assure that sample tag numbers are recorded by the Sample Custodian?
- 
- 
11. Where are written Standard Operating Procedures (SOPs) pertaining to sample storage documented (laboratory manual, written instructions, etc.)?
- 
- 
- 12a. Do written SOPs and actual laboratory practices demonstrate laboratory security?
- 
- 
- 12b. Describe sample storage area (upright refrigerator in GC lab, walk-in cooler in sample receiving area, etc.).
- 
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13. How is sample identification maintained?
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14. How is sample extract (or inorganics concentrate) identification maintained?

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15. How are samples that require preservation stored to maintain their preservation?

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16. How are written Standard Operating Procedures (SOPs) pertaining to sample handling and tracking documented?

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17. What laboratory records are used to record personnel receiving and transferring samples in the laboratory?

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18. Affirm that each instrument used for sample analysis (GC, GC/MS, AA, etc.) has an instrument log? List those instruments which do not.

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19. Determine where analytical methods are documented and ask if methods are available to the analysts?

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20. Determine where quality assurance procedures are documented and ask if procedures are available to the analysts?

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21. How are written Standard Operating Procedures (SOPs) for compiling and maintaining sample document files documented?

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22. How are sample documents filed (by case number, internal laboratory number, batch number, sample number, etc.)?  
\_\_\_\_\_  
\_\_\_\_\_
23. Review sample document files to determine if a document file inventory is prepared for each case file.  
\_\_\_\_\_  
\_\_\_\_\_
24. Review sample document files to determine if all documents in the case files are consecutively numbered according to the file inventories.  
\_\_\_\_\_  
\_\_\_\_\_
25. Observe the document file storage area to determine if the laboratory document files are stored in a secure area.  
\_\_\_\_\_  
\_\_\_\_\_
26. Has the laboratory received any confidential documents?  
\_\_\_\_\_  
\_\_\_\_\_

Complete questions 27, 28 and 29 ONLY if the response to question 26 was yes.

27. Review the case files to assure that confidential documents are segregated from other laboratory documents.  
\_\_\_\_\_  
\_\_\_\_\_
28. Review the case files to assure that confidential documents are stored in a secure manner.  
\_\_\_\_\_  
\_\_\_\_\_
30. Review recommendations from the previous audit to determine if the recommendations have been implemented. If not, the recommendations should be repeated and the laboratory director and the Project Officer should be notified.